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ENVIRONMENTAL SCIENCE

# Environmental Science

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# PREFACE

This book aims to provide a broad ENVIRONMENTAL SCIENCE for the importance of ENVIRONMENTAL SCIENCE is well known in various engineering fields.

It provides a logical method of explaining various complicated concepts and stepwise methods to explain essential topics. Each chapter is well supported with the necessary illustrations. All the chapters in the book are arranged in a proper sequence that permits each topic to build upon earlier studies.

ENVIRONMENTAL SCIENCE is a critical research area. The techniques developed in this area so far require to be summarized appropriately. In this book, the fundamental theories of these techniques are introduced.

The brief content of this book is as follows-

**Chapter 1 Environment and Eco System**

**Chapter 2 Natural Resources**

**Chapter 3 Biodiversity and Biotic Resources**

**Chapter 4 Environmental Pollution and Control Technologies**

**Chapter 5 Environmental Policy, Legislation & Eia**

**References**

This book is original in style and method. No pains have been spared to make it as compact, perfect, and reliable as possible. Every attempt has been made to make the book a unique one.

In particular, this book can be handy for practitioners and engineers interested in this area. Hopefully, the chapters presented in this book have just done that.

# ACKNOWLEDGMENTS

Take it from me, writing a book takes time, patience, and motivation in equal measures. The challenges can sometimes be overwhelming, and it becomes straightforward to lose focus. However, analytics, patterns, and uncovering the hidden meaning behind data have always attracted me. When one considers the possibilities offered by comprehensive analytics and the inclusion of what may seem to be unrelated databases, the effort involved seems almost inconsequential.

We also have to acknowledge the many vendors in the Internet of Things arena who inadvertently helped me along my journey to expose the value contained in data.

Writing takes a great deal of energy and can quickly consume all of the hours in a day. With that in mind, I have to thank the numerous editors whom we have worked with on freelance projects while concurrently writing this book. Without their understanding and flexibility, we could never have written this book or any other.

When it comes to providing the ultimate encouragement and support, no one can compare with my family time and be still willing to provide me with whatever we needed to complete this book. We are very thankful to have such a wonderful and supportive family.

# CONTENTS

# CHAPTER 1

# ENVIRONMENT AND ECO SYSTEM

## 1.1 INTRODUCTION OF ENVIRONMENT:

The environment refers to the natural world around us, including all living and non-living things. It includes everything from the air we breathe, the water we drink, the soil we walk on, and the plants and animals that inhabit our planet.

The environment is crucial to our survival and well-being, as it provides us with the resources we need to live, such as food, water, and shelter. It also plays a vital role in regulating the Earth's climate, air and water quality, and biodiversity.

Human activities such as pollution, deforestation, and climate change have a significant impact on the environment, and these actions can have far-reaching consequences for our planet and its inhabitants. Therefore, it is essential to protect and conserve the environment to ensure the sustainability of our planet for future generations.

### Definitions of Environment

The term "environment" refers to the surroundings, conditions, and factors that influence the development and behavior of living organisms. It can be broadly defined as the natural and physical world around us, including living and non-living things, and the interactions between them.

Here are some more specific definitions of environment:

1. The natural and physical world in which an organism lives, including the air, water, soil, and other living and non-living things.
2. The conditions and circumstances that affect an organism's well-being and survival, including factors such as climate, pollution, and human activity.
3. The total complex of external factors that affect an organism or a community, including social, cultural, and economic factors as well as natural ones.

4. The sum total of all the conditions and influences that surround and affect an organism or group of organisms.

Overall, the concept of environment encompasses a wide range of factors and influences that shape the world we live in and impact the well-being of all living organisms.

## 1.2 TYPES OF ENVIRONMENT

There are several types of environments, which can be broadly categorized into natural environments and built environments. Here are some common examples:

1. **Natural environments**: These are environments that exist without human intervention or influence. Examples include:
- Forests and jungles
- Oceans, lakes, and rivers
- Mountains and hills
- Deserts and arid regions
- Tundra and polar regions
- Grasslands and savannas
2. **Built environments:** These are environments that are created by humans for their own use. Examples include:
- Urban environments, such as cities and towns
- Residential environments, such as houses and apartments
- Industrial environments, such as factories and warehouses
- Commercial environments, such as shopping malls and office buildings
- Transportation environments, such as roads, bridges, and airports
3. **Virtual environments:** These are environments that are created through computer graphics and virtual reality technology. Examples include:
- Video game environments
- Simulations for training or education
- Virtual reality experiences for entertainment or therapy
4. **Social environments**: These are environments that are created by human social interactions and relationships. Examples include:
- Family environments
- School or educational environments

- Workplace environments
- Political or cultural environments

Online or digital environments, such as social media platforms or online communities.

## 1.3 SCOPE AND IMPORTANCE OF ENVIRONMENT

The environment encompasses everything around us, including the natural world and the built environment we have created. The scope of the environment is broad and includes the air we breathe, the water we drink, the food we eat, the land we live on, the climate we experience, and the ecosystems and biodiversity that support life on Earth.

The importance of the environment cannot be overstated. It is the foundation of life, providing us with the resources and services necessary for our survival, such as clean air, water, and food. The environment also supports our economic well-being, providing resources for industry and commerce, as well as recreation and tourism.

In addition to its practical importance, the environment also has a cultural and spiritual significance. It is a source of inspiration, beauty, and wonder, and is an integral part of our cultural heritage and identity.

The environment is also intimately linked to human health. Pollution, climate change, and other environmental problems can have significant negative impacts on our physical and mental health, both directly and indirectly.

As such, it is essential that we recognize the scope and importance of the environment and work to protect and preserve it for future generations. This requires a collaborative effort across all sectors of society, including government, business, civil society, and individuals, to promote sustainable development and ensure the long-term health and well-being of our planet and its inhabitants.

### IMPORTANCE OF ENVIRONMENTAL STUDY

Environmental study is of great importance in our world today. The environment is essential to our survival, and studying it helps us to

understand how to protect it, prevent its degradation, and promote its sustainable use. Here are some reasons why environmental study is important:

1. Understanding the environment: Environmental study helps us understand the various components of the environment, including the natural resources, climate, and the ecosystems, among others. This understanding is critical in identifying the potential threats to the environment and developing ways to mitigate them.

2. Sustainability: Environmental study helps us promote sustainability, which is the ability to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. Sustainability is essential to maintaining the environment, which in turn supports the survival of human beings.

3. Conservation: Environmental study helps us identify the importance of conserving natural resources such as forests, water, and wildlife. Through conservation efforts, we can preserve these resources for future generations, maintain their ecological balance, and prevent their depletion.

4. Environmental policy: Environmental study plays a critical role in developing environmental policies and regulations that aim to protect the environment. These policies ensure that the environment is protected from harmful human activities and that natural resources are used sustainably.

5. Environmental education: Environmental study promotes environmental education, which is essential in creating awareness and understanding of environmental issues. This education empowers individuals to make informed decisions and take actions that contribute to protecting the environment.

In summary, environmental study is essential to our survival and the survival of our planet. It helps us understand the environment, promotes sustainability, conservation, and the development of environmental policies and regulations. It also fosters environmental education, which is

critical in creating awareness and understanding of environmental issues.

## 1.4 PUBLIC AWARNESS TO ENVIRONMENTAL ISSUES/STUDIES

Public awareness of environmental issues and studies is crucial in promoting sustainable development and protecting the planet for future generations. Here are some ways that public awareness can be raised:

1. Education: Environmental education in schools and universities can help students understand the importance of environmental protection and how to reduce their ecological footprint.

2. Media: The media can play an important role in raising awareness about environmental issues through news articles, documentaries, and other forms of media coverage.

3. Public campaigns: Governments, non-governmental organizations, and other groups can organize public campaigns to raise awareness about environmental issues, such as recycling, reducing energy consumption, and protecting endangered species.

4. Community outreach: Community outreach programs can help to engage the public in environmental issues by providing information and resources on how to reduce waste, conserve water, and support conservation efforts.

5. Public participation: Encouraging public participation in environmental decision-making processes can help to ensure that the public's concerns are heard and addressed.

Overall, raising public awareness about environmental issues is critical in promoting sustainability and protecting the planet. By educating the public, encouraging participation, and engaging communities, we can all work towards a more sustainable future.

**Methods to propagate environmental Awareness:**

There are several effective methods to propagate environmental awareness:

1. Education: The most important way to propagate environmental awareness is through education. This can be done through schools, universities, and community organizations. Environmental education can include classes, workshops, seminars, and field trips.

2. Public Campaigns: Public campaigns can be run on a large scale to raise awareness about environmental issues. These campaigns can include posters, billboards, and advertisements on television, radio, and the internet.

3. Social Media: Social media is a powerful tool for spreading awareness. It can be used to share environmental news and information, as well as to promote environmentally-friendly practices and products.

4. Volunteer Work: Volunteering for environmental causes is a great way to raise awareness and make a positive impact. Volunteers can work with local organizations to clean up beaches, plant trees, and promote sustainable living practices.

5. Government Policies: Government policies can be used to promote environmental awareness. For example, policies can require companies to report their environmental impact or mandate the use of sustainable energy sources.

6. Eco-tourism: Eco-tourism is a growing industry that promotes sustainable travel practices. It can be used to educate people about the importance of environmental conservation while providing them with an enjoyable experience.

7. Recycling Programs: Recycling programs can help raise awareness about the importance of waste reduction and recycling. They can be set up in schools, businesses, and public spaces to encourage people to recycle.

Overall, it is important to use a variety of methods to raise awareness about environmental issues. This can help ensure that a broad range of people are reached and engaged in the effort to protect the environment.

**Public awareness is needed in the area**

1) study into the preservation and administration of natural resources.

2) Ecosystem and genetic biodiversity conservation

3. Preventing Pollution in the Environment.

4. The environment and development-related social concerns.

5.the state of the environment and human population A Simple Explanation of the Ecosystem.

## 1.5 ECOSYSTEM

An ecosystem is a community of living organisms and their interactions with the non-living components of their environment. It includes both biotic (living) and abiotic (non-living) factors such as soil, water, air, climate, and physical geography.

Ecosystems can range in size from small ponds to entire biomes like the Amazon rainforest or the Arctic tundra. They can also vary in complexity, from simple ones that are composed of only a few species to highly diverse ones that contain many different species.

The functioning of an ecosystem is dependent on a complex web of relationships between its various components. Producers, such as plants, use energy from the sun to create food, which is then consumed by consumers such as herbivores, which are in turn consumed by predators. Decomposers, such as bacteria and fungi, break down dead organic matter and recycle nutrients back into the ecosystem.

Human activities can have a significant impact on ecosystems. Habitat destruction, pollution, and climate change can all cause significant harm to ecosystems, which can lead to the loss of biodiversity, reduced ecosystem services, and even the collapse of ecosystems. Therefore, it is important to understand and manage ecosystems in a way that ensures their health and resilience.

### 1.5.1 ECOSYSTEM CHARACTERS

**Structural features** is made up of the composition and organisation of both biotic communities and abiotic components.

**Biotic structure** Plants, animals, and microbes all make up a system's biotic structure. -nutritional behaviour and status in the ecosystem – producers or consumers – how do they receive their food?

**STRUCTURE OF ECOSYSTEM**

nonliving, physical, or abiotic elements

Biological or animate elements

Energy components,

**Abiotic Components:**

number three.Abiotic parts can enter living things directly or indirectly, take part in metabolic processes, and then leave the body through waste.

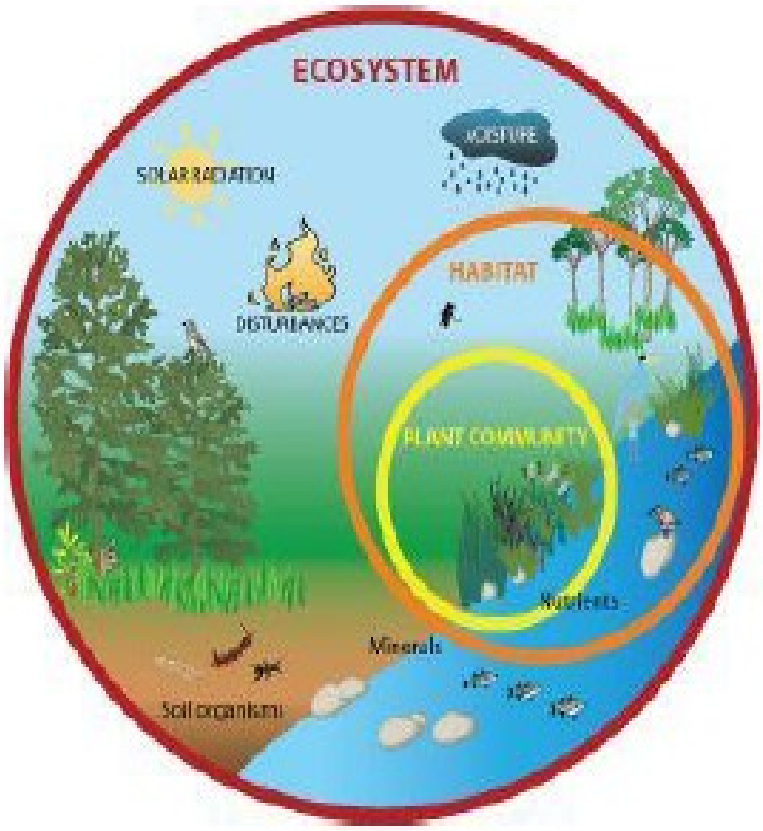


**FIG 1.1 ECOSYSTEM**

Listed below are examples of abiotic components:

1: The Atmosphere The atmosphere is the layer of air that surrounds Earth. N2O (78%), O2 (2%) and other gases (1%).

2.Internal Earth (lithosphere), Solid Earth (radius: 6371), Density: -5.5

3. the hydrosphere contains just 3% of the total water on Earth, while most of the water on our planet is found in the oceans (97%).

**STRUCTURE OF ATMOSPHERE**

**Five Layers**

1. Troposphere – lower portion – extends from 0-18 kms, temperature-2.
2. Stratosphere -18- 50 kms- Temperature (-2°C to -56°C ) - Ozone layer3.
3. Mesosphere- extends from 50-85 kms- Temperature drops to (-95°C)4.
4. Ionosphere or Thermosphere – extends up to 500 kms. Temperature – raises up to 1200°C5.
5. Exosphere – extends up to 1600 km- temperature very high due to solar radiation

**Functions of Atmosphere:**

It maintains heat balance on the earth by absorbing IR radiation.

Oxygen– support life on living organism.

Co2 - essential for photosynthetic activity of plants.

N2 - essential nutrient for plant growth.

**Interior of Earth or Lithosphere:**

**Three major Zones**

1. Crust – top most layer- solid thickness 30 – 40 Km in continents and 5– 6 km in oceans.

Rocks of the earth crust– 3 types– Igneous, Sedimentary, Metamorphic.

2. Mantle – average density 3.3 – Thickness – 2860 – density increases with depth.

3. Core – outer core – solid, inner core – liquid). Depth – 2900 km from the surface of the earth – density -12 – not exact composition.

**Functions of Lithosphere:**

1. It is home for human beings and wild life

2. It is store house of minerals and organic matter

**Functions of Ecosystems -** Ecosystem characteristics

**Biotic structure** – Plants, animals , microorganisms – form biotic components – nutritional behavior and status in the ecosystem – producers or consumers – how do they get their food.

**Producers** – Photosynthesis – photoautotroph (auto – self, photo- light) Chemotrops or Chemosynthetic organisms – Chemicals

**Consumers** – feeding upon other organisms

**Types – Herbivores** – Plant eating animals – primary consumers Eg ; rabbit

**Carnivores** – Feed on consumers – Secondary Consumers - feed on other carnivores – Tertiary/Consumers.

**Omnivores** – feed on both plants and animals – eg. Humans, rat, fox.

**Detritivores** - (Detritus feeder or Saprotrophs ) – feed on dead on organisms or decomposed matter eg; beetles, termites, ants , crabs, earthworms.

**Decomposers** – nutrition breaking down in to complex organic molecules to simpler organicorganic compounds – bacteria and fungi.

**Abiotic Structure** – physical and chemical components of an ecosystem.

**Physical factors** – sunlight, temperature, annual rainfall, soil type, water availability, water currents etc. – strong influence on the ecosystem.

**Chemical factors**: major essential nutrients – C, N, P, H, O, S.

**Biotic Components** – Abiotic components and vice versa – linked through – energy flow, matter cycling

**Functional Attributes.**

1. Food chain, Food web and trophic structure.

2. Energy flow

3. Cycling of Nutrients (Biogeochemical cycles)

4. Primary and secondary production

5. Ecosystem development programme

**Food Chains**

Sequence of eating and being eaten in an ecosystem.

**Grass □□Grasshopper □□Frog □□snake □□Hawk**

(Grassland Ecosystem)

Grazing food chains – Starts with green plants.

Grass □□Rabbit □□Fox

**Phytoplanktons □□Zooplanktons □□Small fish □□Carnivores( fish)**

**Food Web**

An interlocked food chain is called as a food web. (Network of food Chains)

## 1.6 ENERGY FLOW IN ECOSYSTEM

Energy flow is the process through which nutrients are transferred from autotrophs to heterotrophs, which in turn aids in the preservation of biological diversity. Natural sunlight is the ecosystem's primary energy source. Over 80% of energy is wasted during the process of moving energy from one trophic level to the next.

Sun->Herbivores->Carnivores->Top Carnivores->Decomposers

**FOOD CHAIN**

Connections in the food system Through the process of photosynthesis, plants are able to transform solar energy into their own protoplasm. To gain protein, small herbivores eat animal matter, which is then eaten by huge carnivores. Food energy is transferred along the food chain when organisms are eaten and eaten in turn. Decomposer: Primary Consumer, Secondary Consumer, Tertiary Consumer

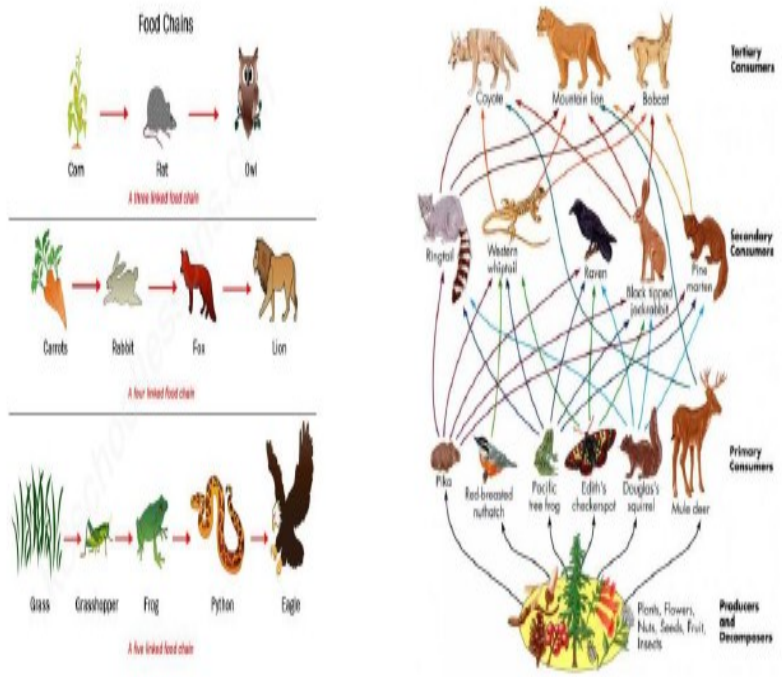


**FIG 1.2 FOOD CHAIN**

## 1.7 FOOD ON WEB

All conceivable prey and predators of varying food levels are linked to illustrate the food interaction between different organisms. A food web is the result of an ecosystem's interconnected network of feeding relationships.

**Difference between food chain and food web**

In a linear food chain, if one species is hurt or goes extinct, it will affect all of the species in the next trophic level.

However, if just one species is affected in a food web, the affect-on effects are far less severe at the higher trophic levels.

Each trophic level has a number of potential outcomes.

## 1.8 ECOLOGICAL PYRAMIDS

Ecological pyramids show a decline in the energy biomass and number of organisms as one moves from the producing level to the consumer level. To a greater extent than not, the mass of herbivores in an ecosystem will be less than the mass of plants. Similar to how the total mass of herbivores will be greater than that of carnivores, the reverse will also be true. The ecological pyramid is a graphical depiction of the number, biomass, and energy of different energy levels. The producer is the base of every ecological pyramid, and the tiers above him or her are the tyres on which the pyramid rests and ultimately rises. Both the tropic structure and the tropic function of the ecosystem are reflected in the pyramidal shape of the ecological pyramids.

**Types of ecological pyramids:**

a) Pyramid of numbers

b) Pyramid of biomass

c) Pyramid of energy

**Pyramid of number**

The number of numbers forming a pyramid

The number of species at each trophic level in the tropics is shown.

The animals at the bottom of the food chain (the "base of the pyramid") are the most numerous.

There are fewer and fewer carnivores at the top of the food chain because the number of carnivores in each succeeding link decreases so quickly.

The number pyramid doesn't take into account how much biomass an organism has. It also doesn't show how much energy is passed from one group to another or how much energy each group uses.

The grassland ecosystem is a good model for the "pyramid of numbers" number.

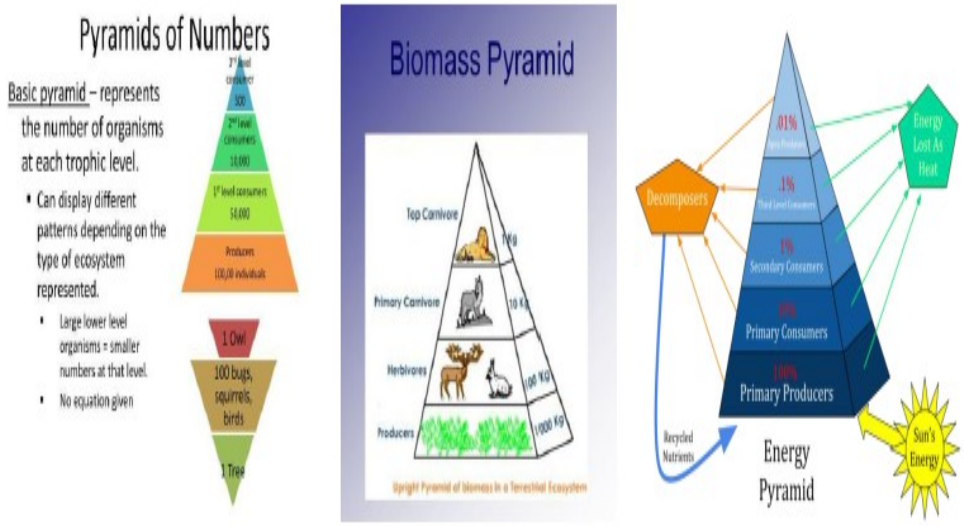


**FIG 1.3 VARIOUS PYRAMIDS IN ECOSYSTEM**

**Pyramid of biomass**

The biomass of the organisms present at any given stage throughout the food chain. From the base of the pyramid to the top, the tropical biomass experiences a net loss of biomass.

In one ecosystem, the biomass of the producers that herbivores eat is greater than the biomass of the herbivores themselves.

Similarly, the principal carnivores' (or secondary consumers') total biomass will be lower than the herbivores', and so on.

**Pyramid of energy**

When energy is considered as a factor in production, the pyramid not only shows how much energy is transferred at each level but also how each organism contributes to the overall process. How many living organisms may be created in a given amount of time is the basis upon which the energy pyramid rests.

## 1.9 ECOLOGICAL SUCCESSION

An area's original community may provide community to a new one or many new ones.So, ecological succession is the process by which one community gives way to another over time until a stable community forms in a certain area.

**Ecological succession occurs in stages.**

**1. Pioneer community**

The pioneer community consists of the first organisms that colonise a new area.

**2. Seres (or) Seral stage**

The term "seres" is used to describe the several phases during which a community grows.

**Types of ecological succession**

**Primary succession** It involves the gradual establishment of biotic communities on a lifeless ground.

**(a) Hydrarch (or) Hydrosere**: Establishment starts in a watery area like pond and lake.

**(b) Xerarch or Xerosere:** Establishment starts in a dry area

like, desert and rock.

**2. Secondary succession:** It involves the establishment of biotic communities in an area, where some type of biotic community is already present.

**Process of Ecological Succession**

**1. Nudation**: It is the development of a bare area without any life form.

**2. Invasion:** It is the establishment of one or more species on a bare area through migration followed by establishment.

**(a) Migration:** Migration of seeds is brought about by wind,

water or birds.

**(b) Establishment:** The seeds then germinate and grow on the land and establishes their pioneer communities.

**c) Competition.** As the number of individual species grows , there is a competition with the same species and between different species for space, water and nutrients.

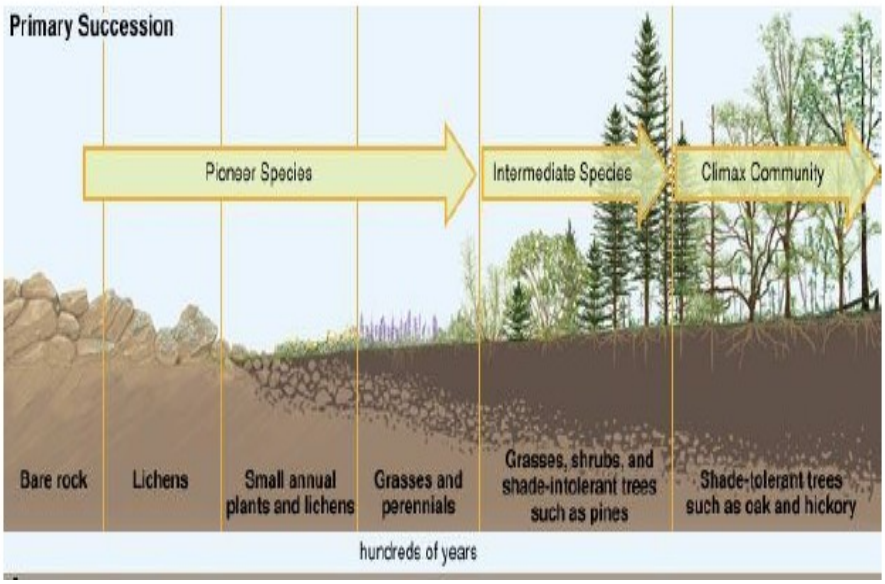


**FIG 1.4 SECONDARY SUCCESSION**

**d) Reaction**. The living organisms take water, nutrients and grow & modify the environment is known as reaction. This modification becomes unsuitable for existing species and favours some new species, which replace the existing species. This leads to seral communities.

e) **Stabilization.** It leads to stable community, which is in equilibrium with the environment.

## 1.10 MAJOR TYPES OF ECOSYSTEMS

**Forest Ecosystem**

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

Tropical rain forests → found near the equator, high temperature, have broad leaf trees like sandal, lion, tiger

Tropical deciduous forest → Found away from equator, warm climate, deciduous trees like maple, oak, deer, fox, rabbit etc.

Temperate rain forests → adequate rainfall areas, coniferous trees like pines, firs, squirrels, fox, cats, bear etc.

Temperate deciduous forest → found in moderate temp., trees like oak, hickory, animals – deer, fox, bear etc.

Tropical scrub forests → dry climate for longer time, small deciduous trees & shrubs, animals – deer, forx etc.

**FIG 1.5 FOREST ECOSYSTEM**

**Characteristics of forest ecosystem:**

- Characterized by warm temperature, adequate rainfall
- Maintain climate & rainfall
- Support many wild animals & protect biodiversity
- Soil is rich in minerals, so support growth of trees
- Penetration of light is poor so conversion of organic matter is very fast.

**Characteristics:**

Abiotic: soil, sun light, temperature etc Biotic: forest trees, shrubs and animals

**I. Abiotic Components** → abiotic components are physical components present in soil & atmosphere (Ex) tempereature, light, rainfall, minerals

Abiotic Components of Ecosystem

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.

The abiotic factors vary from ecosystem to ecosystem. In an aquatic ecosystem, the abiotic factors may include water pH, sunlight, turbidity, water depth, salinity, available nutrients and dissolved oxygen. Similarly, abiotic factors in terrestrial ecosystems can include soil, soil types, temperature, rain, altitude, wind, nutrients, sunlight etc.

Here, the sun is the energy source. Producers/plants use this energy to synthesize food in the presence of carbon dioxide and chlorophyll. The energy from the sun, through several chemical reactions, turns into chemical energy.

Learn more about the Biogeochemical Cycle in more detail here.

The herbivores are dependent on plants for the energy requirements. The carnivores, in turn, feed on the herbivores and other carnivores. At any level, microbes then decompose any dead and decaying organic matter. These decomposers, after various chemical reactions, release molecules back to the environment in the form of chemicals. The chemicals are again used by the producers, and the cycle starts again.

In conclusion, ecosystems have a complex set of interactions that happen between the biotic and abiotic components. The components of an ecosystem are linked to each other through the energy flows and nutrient cycles. Even though ecosystems do not have clear boundaries, these interactions get affected, even if one factor is changed or removed. This ultimately has the capacity to affect the entire ecosystem.

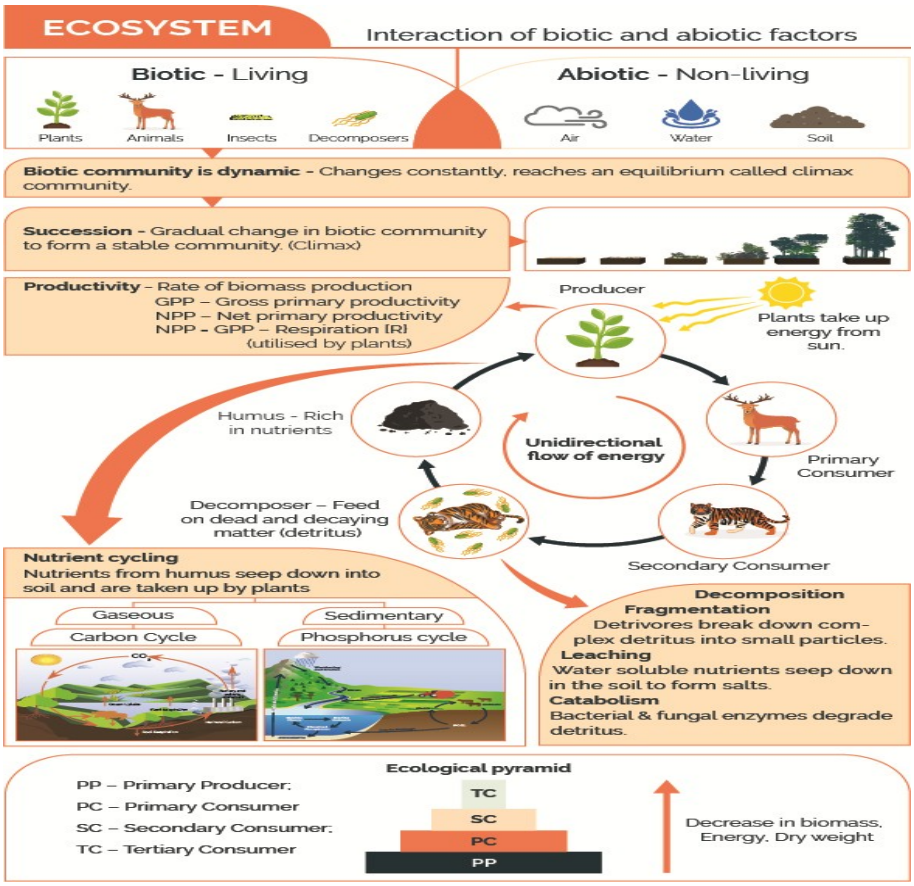


**FIG 1.6 ABIOTIC COMPONENTS**

**II. Biotic Components**

**1. Producers** → plants absorbs sunlight & produce food by photosynthesis. Ex-trees, shrubs, plants

**2. Consumers**

**Primary consumers** → Called herbivores/plant eaters- depend on plants for food. Ex. Insects, rat, goat, deer, cow, horse etc

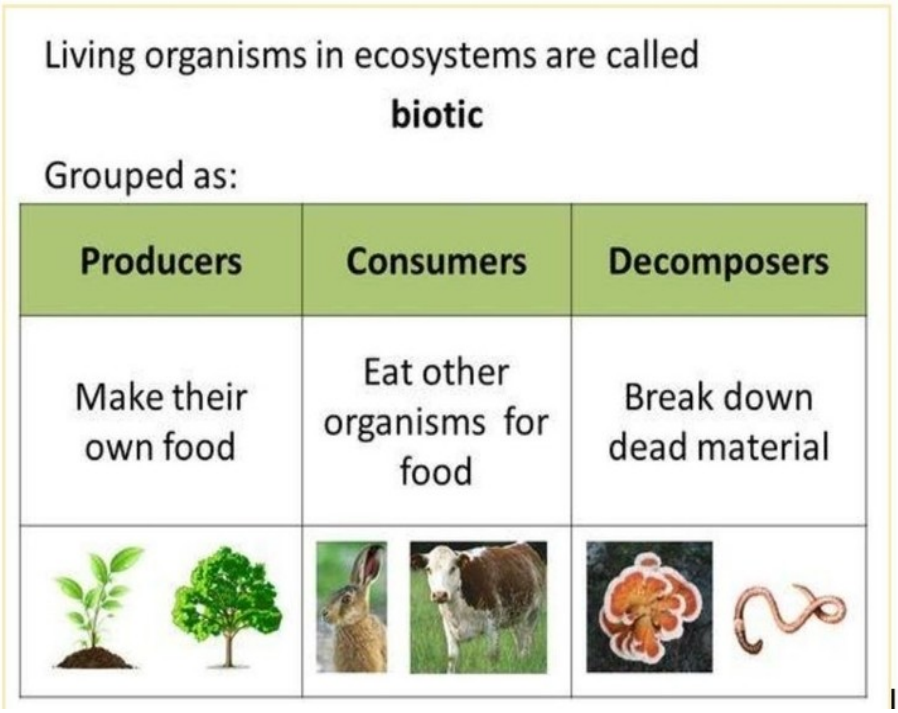


**FIG 1.7 BIOTIC COMPONENTS**

**Secondary consumers** → Called primary carnivores/meat eaters. Depend on herbivores for food Ex. Frog, birds, cat, snakes, foxes etc.

**Tertiary consumers** → Called Secondary carnivores, feed on secondary consumers. Ex. Tigers, lions etc.

**Decomposers:** fungi, bacteria

### 1.10.1 GRASSLAND ECOSYSTEM:

**Dominated by grass**—few shrubs and trees are also found—average but irregular—overgrazing leads to desertification.

**Three types – depending on the climate**

1. Tropical grass lands – found near the boarders 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.

2. 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.

3. Polar grasslands – found in arctic polar region – organism – arctic wolf, fox, etc. – Athick layer of ice remains frozen under the soil surface throughout the year – known as permafrost – summer insects and birds appear

**FIG 1.7 GRASSLAND ECOSYSTEM**

**Components:**

**Structural Components: Abiotic Factors** Soil and air conditions, including factors like temperature, light, precipitation, and mineral content, are examples of abiotic factors.

**Biological Substances**

**Producers**—plants take in sunlight and make food via a process called photosynthesis. ex-trees, ex-shrubs, ex-plants

**Consumers** Herbivores are the primary consumers since they eat only plants. For instance, insects, rats, goats, deer, cows, horses, etc.

**Primary consumers** They are also known as meat eaters or carnivores. Animals like frogs, birds, cats, snakes, foxes, and so on depend on herbivores for food.

**Secondary consumers** → Called primary carnivores/meat eaters. Depend on herbivores for food Ex. Frog, birds, cat, snakes, foxes etc.

**Tertiary consumers** → Called Secondary carnivores, feed on secondary consumers. Ex. Tigers, lions etc.

**Decomposers** → Organisms which feed on dead organisms, plants & animals & decompose into simpler compounds Ex.

### 1.10.2 DESERT ECOSYSTEM

About 35% of the Earth's surface is desert. Rainfall totals of fewer than 25 centimetres are typical. The atmosphere is devoid of moisture, making it a poor insulator.

**Types:**

1. The Thar Desert is a tropical wasteland found in Rajasthan, India,
2. the Sahara Desert of Africa The mild climate of the southern California-Majave desert
3. China's Gobi Desert and the Cold Desert

**Fig 1.8 DESERT ECOSYSTEM**

**Characteristics:**

1 Air is dry

2 Climate is hot

3 Annual rainfall is less than 25 cm

4 Vegetation is poor

**Structure and functions of the desert Ecosystems**

**Abiotic Components -** Eg. Temperature, rainfall, sunlight, water, etc.

**II. Biotic Components**

**1. Producers Eg**. Shrubs, bushes, some grasses and few trees.

In deserts mostly Succulent (e.g., cacti) plants are found available. They have waxy layer on the outside to protect them from the sun.

**2. Consumers** Eg. Squirrels, mice, foxes, rabbits, deer and reptiles

### 1.10.3 Aquatic Ecosystem

**Definition** It discusses the biotic communities of water systems, which may be broken down into two categories: freshwater and marine. There are two main kinds of freshwater ecosystems: lentic and lotic.

**Types:**

1. **Pond ecosystem**

A miniature, freshwater ecosystem teeming with algae, aquatic plants, insects, fish, and other seasonal creatures. Human activities such as washing clothes, bathing, bathing livestock, swimming, etc., put a lot of strain on ponds.

2. **Lake ecosystem:**

the lake ecosystem is a common freshwater ecosystem that often exhibits zonation or stratification, particularly in the warmer months of the year.

The top layer is the littoral zone, which is shallow, warm, and vulnerable to human activities.

the second layer receives sufficient sunlight and has significant primary production.

Limnic region Lower than the second layer, the profundal zone receives little or no sunlight.

Like Srinagar's Dal Lake and Nainital's Naini Lake Organisms: Phytoplankton, such as algae, and zooplankton, such as rotifers, are both types of plankton. Those fish that live in water, like fish, are called nektons. Things called "neustons" float on the water's surface. Benthic organisms are those that live in or on the sediments, like snails.

**Types of lakes**:. You have oligotrophic lakes, which have low nutrient levels; eutrophic lakes, which have high nutrient levels due to fertiliser contamination; desert salt lakes, which have highly salty water because of evaporation; volcanic lakes, which are formed by water emitted from magma during volcanic eruptions; dystrophic lakes, which have highly

acidic water (low pH); endemic lakes, which have many endemic species; and so on.

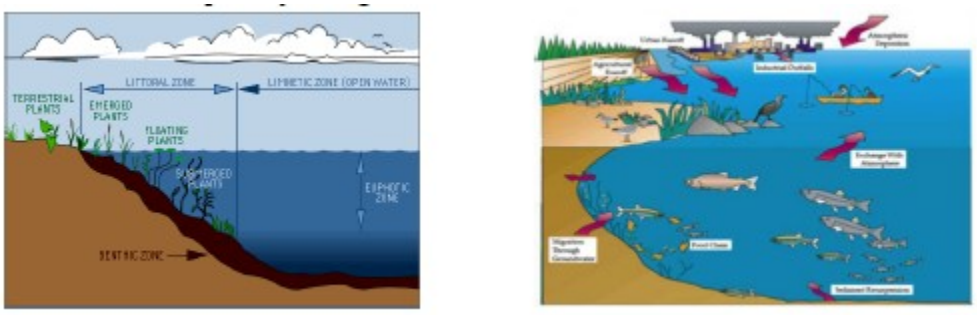


**FIG 1.9 LAKE ECOSYSTEM**

**Streams** are a kind of aquatic ecosystem in which the flow of water plays a significant role. Both the oxygen and nutrition levels are consistent. Unlike their pond and lake counterparts, organisms found in organisms are not negatively affected by oxygen shortages, despite having to adapt to wildly varying environmental circumstances. This is because a greater volume of moving water results in a greater area of oxygen on the surrounding surface. The animals can only tolerate a small drop in oxygen levels. Streams are thus the areas most affected by industrial pollution.

**River ecosystem:**

**FIG 1.10 RIVER ECOSYSTEM:**

: long waterways that originate in the mountains. First, you'll find oxygen-hungry fish and plants clinging to rocks in regions with high concentrations of precipitation and running water. Hillside vegetation and fish that can thrive with less oxygen are more abundant in the second phase, when the climate is warmer and the hills are more gently sloping. In the third stage, the river reshapes the landscape by transporting silt and nutrients, which are then deposited in the delta and the plains, creating a very biodiverse region.

The oceans are enormous water reserves that account for more than 70 percent of the Earth's surface; they are home to more than 2.5 million species; they produce a wide range of useful products and drugs from the sea; they are a significant source of essential minerals like iron and magnesium; they absorb large quantities of carbon dioxide; they are a significant source of oil and natural gas; they are a major source of energy. The coastal zone, which is warm, nutrient-rich, shallow, and receives a lot of sunlight, has the highest rates of primary production.

Zones of open water are separated by depth, beyond the continental shelf. 1. the eutrophic zone, which is rich in plant life and sunlightLuminous attenuation in the bathyal zone 3. the world's largest ecological unit, the abyssal one dark zone

**Characteristic features of Ocean Ecosystem**

**FIG 1.11 OCEAN ECOSYSTEM**

For one, it has a lot of surface area, is rich with salty water, and is teeming with all kinds of biodiversity.

Submarines and ships may now travel the oceans, opening up new opportunities for trade.

Thirdly, it helps keep the earth's average temperature stable.

**Structure and function of Ocean Ecosystems**

**Abiotic Factors** are heat, light, saltiness (especially sodium chloride and potassium chloride), pH, and alkalinity.

**Biotic Components**

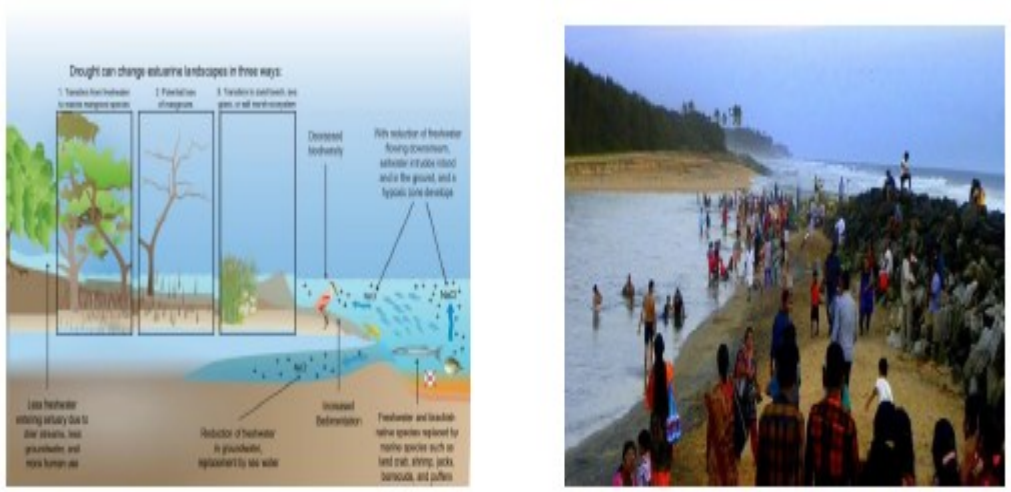


**FIG 1.12 BIOTIC COMPONENTS**

Materials With Biological Origins 1) producers (seaweeds, chlorophyceae, phaeophyceae), which include marine plants and phytoplankton (diatoms, unicellular algae, etc.).Primitive consumers include crustaceans, molluscs, and fish. Sahd, Mackerel, and Herring are available in the secondary market.Consumers in the third tier, for fish like cod, haddock, and the like Decomposers, such as bacteria and some types of fungi, are essential to the recycling process. The estuary: a coastal area where a river meets the ocean; greatly affected by tidal activities; rich in nutrients; rich in biodiversity too; organisms are very tolerant; many species are endemic; high food production; yet, it should be protected from pollution.

**Characteristics:**

**Structural Components:**

Abiotic factors include things like pH, nutrients, D.O, temperature, weather, and more. Insects, birds, fish, mammals, fishes, and fungi are all examples of phytoplankton. Here's how the energy chain from phytoplankton to insects to juvenile fish to adult fish to fishes works

# CHAPTER 2

# NATURAL RESOURCES

## 2.1 INTRODUCTION

Natural resources are materials and substances that occur in nature and are used by humans for various purposes. These resources can be either renewable or non-renewable.

Renewable natural resources include resources that can be replenished over time, such as sunlight, wind, water, biomass, and geothermal heat. These resources are considered renewable because they are naturally replenished at a rate that is equal to or faster than the rate at which they are used.

Non-renewable natural resources include resources that are finite and cannot be replaced once they are used up, such as fossil fuels (oil, natural gas, coal), minerals (iron, copper, gold), and precious stones (diamonds, rubies). These resources take millions of years to form and cannot be replenished in human timescales.

Natural resources are essential to human survival and development. They are used for a wide range of purposes, including food production, energy generation, construction, transportation, and manufacturing. However, the exploitation of natural resources can also have negative environmental and social impacts, such as deforestation, air and water pollution, and displacement of indigenous communities. Therefore, it is important to manage natural resources sustainably to ensure their availability for future generations.

## 2.2 TYPES OF NATURAL RESOURCES

Natural resources are materials or substances that are found in the natural environment and can be used for economic gain. There are different types of natural resources, including:

1. Renewable resources: These are resources that can be replenished naturally, either through natural processes or human intervention. Examples include solar energy, wind energy, water, timber, and crops.

2. Non-renewable resources: These are resources that cannot be replenished, or that take a very long time to be replenished, once they are used. Examples include fossil fuels such as coal, oil, and natural gas, as well as minerals like copper, gold, and iron.

3. Inexhaustible resources: These are resources that are virtually unlimited in supply and are not likely to be depleted. Examples include solar energy, wind energy, and geothermal energy.

4. Biotic resources: These are resources that come from living organisms, such as plants and animals. Examples include timber, food, and medicinal plants.

5. Abiotic resources: These are resources that come from non-living things, such as minerals and fossil fuels.

6. Natural ecosystems: These are resources that are provided by natural habitats, such as forests, wetlands, and coral reefs, and include services such as water purification, soil fertility, and biodiversity.

Understanding the different types of natural resources is important for managing them sustainably and ensuring that they are used in a way that is environmentally and economically sustainable.

**Perpetually Renewable Resources**

**FIG 2.1 NATURAL RESOURCES**

Perpetually renewable resources are the easiest resources to understand; these are natural resources that are constantly replenished by the Sun's and Earth's natural processes. For example, every day the sun delivers an average of 198 Watts of energy to every square meter (m2) of the Earth's surface. For comparison a standard incandescent light bulb in a bedside lamp uses 40 Watts, or a 100kg person climbing a step in 2 seconds uses roughly 200 Watts. Every day without fail for the last 5 billion years (plus or minus a few hundred million years) the Sun has delivered this solar energy.

Together with geothermal energy (heat from the Earth's interior), the Sun's perpetual energy powers the winds, ocean currents, precipitation and most of the Earth's plant life. Solar and geothermal natural resources currently energise a significant and growing percentage of many nations' electrical grids. It is perpetually renewable in the sense that no matter how much we use in terms of human time-scales (e.g decades to millennia), the Sun and the Earth will always make more.

**Intermediate Renewable Resources**

Intermediate renewable resources are only renewable resources if we don't use them too quickly. They are resources such as freshwater, soil, crops and trees for timber. If we didn't use them, they would be perpetually renewable, but because they require time (on human time-scales) to regenerate or grow, we can overuse them until they are no longer available.

Freshwater is a great example of an intermediate renewable resource. Through the water cycle, the sun evaporates water from the surface of saltwater oceans that travels over land and falls back to earth as freshwater rain. This rain fills the lakes, rivers and aquifers we use for agriculture, industry and drinking water. If we use this freshwater at the same rate as the rain recharging it, then we won't run out. If we use the freshwater faster than it recharges, then we will. Intermediate renewable resources must be carefully managed to ensure they are not depleted.

**Non-renewable Resources**

The last category of natural resources are the non-renewables. These are resources that will not regenerate on human time-scales. Once they have

been depleted they will no longer be available and no more will be made. The most common examples of non-renewable resources are fossil fuels, so-called because most were created by processes that take millions of years. Fossil fuels include crude oil, natural gas, coal and uranium. Other non-renewable resources include metals, lithium and rare-Earth elements (REE's), but it's important to remember that while we may eventually run out of mineable metals and REE's, with careful waste management, these can be recovered through recycling. However, it is not the same for fossil fuels as using them for energy alters their chemistry so they are no longer useful.

**The non-renewable resources are sub classified into**

1. Biotic or organic resources they obtained from biosphere. E.g. forest and forest products, crops, birds, animals, fishes, coal, minerals oils etc.

2. Abiotic or Inorganic resources resources which are composed of non-living inorganic matter are called abiotic resources. E.g., land, water etc.

## 2.3 TYPES OF RESOURCES

1. Forest resource Covers 12% of India's land but estimated value should be 33%. It is renewable resource but overexploitation takes many years to develop hence it become nonrenewable.

2. Water Resource Abundant and inexhaustible renewable resource. It covers 3/4th of land surface of which 1% is fresh water. Most of the fresh water is used for agricultural purposes.

3. Mineral Resources These are nonrenewable and get depleted if over exploited. These are present on land, sea.

4. Food Resources The demand of food supply and the production of food are inadequate and unable to meet the demands of the public due to the overgrowing population. The agricultural production is also declining due to loss of genetic diversity of crop plants, livestock, fishery.

5. Energy Resources Any material in environment that can be used to generate energy for useful purpose. These are renewable and non-energy resources. e.g, solar, wind, water, fossil fuels etc.

6. Land Resources 328 million hectares is Indian land. It is renewable on proper utilization becomes non –renewable if wastes of industries are dumped on land.

**Living and Nonliving resources**

Living resources are Biological resources that are used by Human beings.

Eg. Forests, croplands, animal resources

Non living Resources These are not derived from biological materials.

Eg . Soil, land, water

## 2.4 WATER RESOURCES

Rain is the main source of water on the earth. Clouds released water is called as precipitation. This is basically 3 forms – vaporized (drizzle), liquid (rain), solid form (snow). Water resources can be classified into surface water resources and ground water resources. Main water resources in Andhra Pradesh are Godavari, Krishna and Pennar.

**Forms of fresh water**

Fresh water mainly occurs in two forms Ground water and Surface water.

1. Ground water Ground water constitutes about 9.86 % of the total fresh water resource. It is about 35-50 times that of surface water supplies. The ground water is contained in aquifers. An aquifer is a highly permeable layer of sediment or rock containing water. Layers of sand and gravel are good aquifers, while the clay and crystalline rocks (eg. Granite) having poor permeability are not good aquifers. Aquifers are of two types

i) Un-confined aquifers These are covered by permeable earth materials and are recharged by seeping down of water from rainfall and snowmelt.

ii) Confined aquifers These are present between two impermeable layers of rock and are recharged only in those areas where the aquifer meets the land surface. The recharging area of many confined aquifers may be several kilometer away from the location of the well.

2. Surface water Surface water occurs in the forms of streams, rivers, lakes, ponds, wetlands and artificial reservoirs. It comes through precipitation (rain fall, snow) and accumulated in the water bodies, if not percolated into the ground or not returned to the atmosphere as evaporation or transpiration loss. Surface water mainly used for irrigation of crops, public water supply and industrial supply.

**Uses of Surface and Ground water**

The water is used mainly for two types of uses

1. Consumptive use Here water is completely utilized and it is not reused. E.g. in domestic application, industry and irrigation.

2. Non-consumptive use Here water is not completely utilized and it is reused. E.g. hydropower plant.

Over Utilization of surface and Ground water

The rapid increase in population and industrial growth has increased the demand for water resources. Due to increase of ground water usage, the annual extraction of ground water is in far excess than the natural recharge.

**Effects on Overutilization of water**

1. Decrease of ground water due to increased usage of ground water, the ground water level decreases. Other reasons a erratic and inadequate rainfall.

b reducing the area for percolation of rainfall by building construction.

2.Ground subsidence When the ground water withdrawal is more than its recharge rate, the sediments in the aquifer get compacted, which results in sinking of overlaying land surface. This process is known as

ground subsidence. Leading to structural damage in building, fracture in pipes and reverses the flow of canals.

3. Intrusion of salt water in coastal area, over exploitation of ground water lead to rapid intrusion of salt water from sea by which water can't be used for drinking.

4. Earthquake and landslides.

5. Drying up of wells.

6. Pollution of water.

**FLOODS**

Excess water that overflows stream banks and covers adjacent land is considered a flood.

Cause of Floods It is caused by both natural as well as anthropogenic factors.

Natural factorsprolonged downpour, blocking of free flow of the rivers due to siltation and landslides,heavy rainfall, melting ice or snow or combination of these, exceeds the capacity of the receiving river.

Anthropogenic activities Such as deforestation, over grazing, mining, construction activities, channel manipulation through diversion of river course etc.

Effect of floods

Water spreads in surrounding areas and submerges villages and agricultural fields.

The river carries fertile sediment and deposits it on the level land along its lower course.

Extinction of civilization in some coastal areas also occurs.

Flood management

By constructing dams or reservoirs.

Channel management and embankments.

Encroachment of flood ways should be banned.

By forecasting or flood warning.

By reduction of runoff by increasing infiltration through appropriate afforestation in the catchment area.

The biggest economic loss from floods is usually not the buildings and property they carry away, but rather the contamination they cause.

**DROUGHT**

Drought is lack or insufficiency of imbalance and consequently water groundwater levels and soil moisture.

rain for an extended period, that causes considerable hydrologic shortages, crop damage, stream flow reduction and depletion of

National commission on agriculture (1976) classified the droughts into three types

1. Meteorological droughtIt occurs when the total amount of rainfall is less than 75% of the normal rainfall. This drought will severe if the rain fall is less than 50% of rain falls.

2. Hydrological drought It occurs when the total amount of rainfall is less than the average rainfall. It is generally associated with reduction of statistical average of water reverses available in source such as

aquifers, lakes and reservoirs.

3. Agricultural droughtThis occurs due to the shortage as well as the timing of overall rainfall, which in turn reduce the ground water and reservoir levels, soil moisture. It affects cropped plants.

Causes of drought

When annual rainfall is below normal and less than evaporation.

High population (poor land use and makes the situation worse).

Intensive cropping pattern and over exploitation of water.

Deforestation.

Effects of drought

Hunger, malnutrition and scarcity of drinking water and change the quality of water.

Crop failures leading shortage of food effecting human and livestock population.

Initiates desertification.

Retards the industrial and commercial growth (agro based industry).

Accelerates degradation of natural resources.

Large scale migration of people and urbanization.

Drought Management

Rain water harvesting programme.

Constructing reservoirs to improve ground water level.

Using modern irrigation technology (drip irrigation).

Afforestation.

**DAMS**

For surface water utilization we construct projects like NagarjunaSagar. These projects are useful for production of power, irrigation and water transport and also show effects on people and environment. Based on the size dams are three types – Large, Medium, Small dams. Based on strength dams are Rigid dams and non-rigid dams.

Rigid dams are concrete and masonry dam. Non-rigid dams are earth and rock dams.

Excess water is released to the dam without effect to dam. This is known as flood disposal, this water is called as surplus water.

Purposes of water resources projects

1. Irrigation during dry periods.

2. Ensuring a year-round water supply.

3. Hydroelectricity generation

4. Transfer of water from areas of excess to areas of deficit using canals.

5. Flood control and soil protection.

6. Drinking water.

7. Industrial needs,

8. Fish culture,

9. Recreation, Navigation, Tourism, etc.

Problems/disadvantages of water resources projects

1. Submergence of forests with rare varieties of trees/plants.

2. Adverse effect on wild life and fish life habitat of rare species.

3. Effect on human health and sanitation.

4. Degradation in the fertility of the land – transport of sediment and fertilizer residual.

5. Rehabilitation of displaced persons.

6. Floods.

7. Some dams lose so much water through evaporation and seepage into porous rock beds that they waste more water than they make available.

8. Salts left behind by evaporation increase the salinity of the river and make its unusable when it reaches the downstream cities.

9. Growth of snail populations in the shallow permanent canals that distribute water to fields may lead to an epidemic of Schistosomiasis.

**Dams and their effects on forests and people**

Big dams and river valley projects have multi-purpose uses and have been referred to as "Temples of modern India". However, these dams are also responsible for the destruction of vast areas of forests. India has more than 1550 large dams, the maximum being in the state of Maharashtra (> 600), followed by Gujarat (>250), and M.P (130).

Hydroelectric development is another important factor, which may cause forest destruction.

Submergence of large tracts of forestlands especially in case of large dams is inevitable. This would cause reduction in forest cover, destruction of habitats and extermination of valuable wild species.

Forest submergence would greatly affect the tribal people by the way of submerging their dwellings and agricultural lands. The lifestyle of the tribal is intricately webbed/ connected with the forests. But when the forests are destroyed their livelihood is greatly affected.

It would induce micro-climatic changes in the area in and around the reservoir which may effect the composition of the forests in the area.

It would include changes in the water flow characteristics which may affect the forests and the tribal especially in the downstream areas.

Acute scarcity of fuel wood and other forest products for tribal people.

Increased incidence of water-borne diseases like malaria, filarial, etc.

Disturbance of the dam site forest ecosystem.

**CASE STUDIES**

**1. Silent Valley project**

Project was proposed during 1965 to generate 120 MW of HEPP at a cost of 60 crores on the river Kuntipuza on the south west slopes of Nilgiri hills. The area is covered with a rich virgin forest, of which 1000 hectares will have to be cleared for the project. A 430 m long, 130 m high concrete dam was proposed. The irrigation potential of the project is 10,000 hectares. The project can benefit the most backward regions in Kerala. Silent Valley ecosystem having 1200 plant species per hectare, elephant, barking deer, sambar, lion, rock python etc. animals, 100 rare bird species are affected by these project.

National Committee on Environmental Planning and Coordination (NRPC) refused permission for going ahead with the project.Finally this project proposal was a banded.

**2. Chipco Movement**

During the 1970's commercial loggers started large scale tree felling in the 'Garwal' region of U.P. in India. Landslides and floods resulted due to deforestation. The local people were suffered a lot. With courage and determination, the village women, under the leadership of SundarlalBahuguna, wrapped their arms around the trees to protect them. This was known as "Chipco Movement" or "ChipcoAndolan" (in Hindi- Chipco means hugging or embracing and andolan means movement.)

It is believed that the Chipco movement consists of nearly 4000 groups to save Indian's forest wealth have prevented logging on 1200 sq.km of watershed areas in the Alakananda basin.

It was a slogan of planting 5 F's – Fodder, Fuel, Food, Fiber, and Fertilizer.

Several parts of the country like "the Appico movement in Karnataka".

**3. Narmada Project**

This Rs. 25,000 crore world's largest river valley project consists of 30 major, 135 medium and 3000 minor dams. On the Narmada river and tributaries, flowing through M.P. Maharashtra, Gujarat. Of the 30 major dams, 10 will be on Narmada and 20 on tributaries. The project will submerge 60,000 hectares of fertile land and rich forests. 11,300 hectares of agricultural land will also be submerged.66, 675 people (a majority tribal) have to be displaced.

The environmental damages of this project are – the displaced people will have to be rehabilitated in the forest area leading to loss of more forests. The out sees by and large have to migrate to the nearest cities in search of livelihood. This creates pressure on the urban life.

The compensatory measures are subjected to long delays and corrupt practices, denying justice to the victims of displacement.

On these grounds, the NGO's like Narmada BachavoAndolan led by MedhaPatkar have been fighting for the rights of the tribal displaced by the project. The controversy is still going on.

**4. SardarSarovar project**

The Dam is situated on river Narmada and is spread over three states of Gujarat, Maharastra and M.P. It is one of the costliest project affecting villages in three states of M.P., Maharastra and Gujarat. About 245 villages will be submerged, of which about 193 are in M.P. alone. Over 75,000 (nearly 50,000 in M.P. alone) people will be evicted. Nearly 43,000 ha.of land will be needed for rehabilitation of the our sees in the SardarSarovar Project. A total of 1,44,731 ha of land will be submerged by the dam, out of which 56,547 ha is forest land.

**WATER CONFLICTS**

Conflicts over sharing of river water between neighboring countries or different states of a country have now become quite common because of shortage of water. Some major water conflicts are-

a. Water conflicts in the Middle East In the Middle east countries, three river basins namely the Jordan, the Tigris-Euphrates and the Nile have

the shared water resources. There is a fierce battle for water among Jordan, Syria and Israel for the share of Jordan river water. Turkey has abundant water and plans to build a chain of dams on Tigris-Euphrates for hydroelectric power generation and plans to transport and sell water to other Middle East countries, which may create war like situation in these countries.

b. The Cauvery water dispute The Cauvery river water is a matter of conflict between Tamil Nadu and Karnataka and the fighting is almost hundred years old. Tamil Nadu, occupying the downstream region of the river wants water-use regulated in the upstream, whereas, the upstream state Karnataka refuses to do so and claims it's over the river as upstream user. The river water is almost fully utilized and both the states have increasing demands due to complex cropping pattern and some cash crops demanding intensive water, thus aggravating the water crisis.

c. The Sutlej Yamuna Link (SYL) canal dispute The issue of sharing the Ravi-Beas waters and SYL issue between Punjab and Haryana is a case of dispute between two states. The Supreme Court on January 15, 2002 directed Punjab to complete the work of SYL within a year. But till date neither the SYL has been completed nor is the conflict over sharing of Ravi-Beas water is resolved.

## 2.5 MINERAL RESOURCES

### Minerals

A mineral is a naturally occurring inorganic solid with a definite chemical composition and specific internal crystal structure. Minerals can be metallic e.g. iron, copper, gold etc. or non-metallic e.g. sand, stone, salt, phosphates etc. There are thousands of natural minerals like quartz, feldspar, calcite, topaz, bauxite composed of elements like oxygen, silicon, iron, Mg, aluminum, calcium etc. The eight most common minerals in the world are

Iron 33.3%, Oxygen 29.8%, Silicon 15.6%, Magnesium 13.9%, Nickel 2%, Calcium 1.8%, Aluminum

1.5%, Sodium 0.2%.

Indian mineral resources

India produces 64 minerals, including 4 fuel minerals, 11 metallic minerals and 49 non- metallic minerals.

Ex. Coal, petroleum, bauxite, iron, manganese etc.

Uses and exploitation

Minerals find use in a large number of ways in everyday use in domestic, agricultural, industrial and commercial sectors and thus form a very important part of any nation's economy.

Major reserves and important uses of some of the major metals

| **Metal** | **Major world reserves** | **Major uses** |
|---|---|---|
| Aluminum | Australia, Guinea, Jamaica | Packing food items, transportation, utensils and electronics. |
| Chromium | CIS, South Africa | For making high strength steel alloys,textile/tanning industries. |
| Copper | U.S.A, Canada, CIS, Chili, Zambia | Electronic and electronic goods, building, construction, vessels |
| Iron | CIS, South America, Canada, U.S.A | Heavy machinery, steel production, transportation |
| Lead | North America, U.S.A., CIS. | Leaded gasoline, Car batteries, paints, ammunition. |
| Manganese | South Africa, CIS, Brazil, | For making high strength, high resistant steel alloys |
| Platinum | South Africa, CIS | Automobiles, catalytic converters, electronics, medical uses. |
| Gold | South Africa, CIS, Canada | Ornaments, medical, electronic , aerospace |
| Silver | Canada, South Africa, | Photography, electronics, jewelers |

| | | |
|---|---|---|
| | Mexico | |
| Nickel | CIS, Canada, New Caledonia | Chemical industry, steel alloys |

Major uses of some non-metallic minerals

| **Non-metal mineral** | **Major uses** |
|---|---|
| Silicate minerals | Sand and gravel for construction, bricks, paving etc. |
| Lime stone | Used for concrete, building stone, agriculture for neutralizing acid soils, cement industry. |
| Gypsum | Used in plaster wall-board, in agriculture |
| Potash, Phosphate | Used as fertilizers |
| Sulphur pyrites | Used in medicine, car battery, industry. |

**Benefits of Minerals**

Igneous rocks (igni means fire or Agni) and non-metallic economic minerals like graphite, feldspar, quartz, diamond, that are valued for their beauty and rarity also are exploited badly.

Maximum resources are produced in South America, South Africa. But maximum minerals are consumed by USA, Japan, Europe and then others.

Sand and gravel are extracted for brick and concrete construction, pavements, transportation, filling and sand blasting.

Pure silica is used for glass manufacturing.

Limestone is mixed for concrete, road making, and building stones.

Gypsum (calcium sulphate) is used for plastering.

Potassium for fertilizers.

Sulphur in the form of Pyrite (FeS2) for making H2SO4.

**MAJOR MINERALS IN INDIA**

a. Energy generating minerals

Coal and lignite West Bengal, Jharkhand, Orissa, M.P., A.P.

Uranium (Pitchblende or Uranite ore) Jharkhand, A.P. (Nellore, Nalgonda), Meghalaya, Rajasthan (Ajmer).

b. Other commercially used minerals

Aluminum (Bauxite ore) Jharkhand, West Bengal, Maharastra, M.P., Tamilnadu.

Iron (Haematite and Magnatite ore) Jharkhand, Orissa, M.P., A.P., Taminadu, Karnataka, Maharastra and Goa.

Copper (Copper Pyrites) Rajasthan (Khetri), Bihar, Jharkhand, Karnataka, M.P., West Bengal, A.P., and Uttaranchal.

Environmental Effects of Extracting and using Mineral Resources

The Environmental effects of extracting and using mineral resources depend on such factors as ore quality, mining procedures, local hydrological conditions, climate, rock types, size of operation, topography and several other related factors.

Some of the major environmental impacts of mining and processing operations are

**Degradation of land.**

Pollution of surface and ground water resources due to the release of harmful trace elements (cadmium, cobalt, copper, lead, and others) by leaching, even if drainage is controlled.

Serious adverse impact on the growth of vegetation due to leaching out of trace elements and minerals.

Air pollution due to emission of dust and gases.

Deforestation including loss of fauna and flora.

Adverse impact on historical monuments and religious places.

Physical changes in the land, soil, water and air associated with mining directly and indirectly affect the biological environment.

Rehabilitation of affected population including tribal.

Dereliction (closing or abandoning mines, i.e. deserting and left to fall into ruin) The harmful effects of dereliction include

o Waste of agricultural and industrial land o Ugliness.

Health and accident hazards land over underground mines may subside, causing houses to collapse and ground water pollution.

Shafts that are not filled may lead to accidents.

Old quarries and open-cast pits may also be dangerous.

Permanent damage to landscape.

**Effects of Minerals**

Nonmetal minerals are mainly silicates i.e. sand, limestone and soils.

Extracting and using of this minerals release the particulates into atmosphere. Particulates effect on human health and photosynthesis in plants.

Metal minerals like Gypsum (Calcium sulphate), Potassium etc. are harmful to environment. Metals like Fe, Al, etc. are dangerous to crops.

Natural deposits of fluoride such as topaz, fluorspar (CaF2) and Criolite(Na3Al F6) these contaminate the water.

Fluoride (F) of up to 1mg/l is essential to prevent dental cavities in children.

1.5 mg/l of fluoride causes yellowing of teeth called 'molting'.

>5 mg/l of fluoride causes fluorosis and skeletal abnormalities.

Mineral Resource Management

The efficient use and protection.

Modernization of mining industries.

Search of new deposit.

Reuse and recycling of the metals.

By adopting eco-friendly mining technology.

## 2.6 LAND RESOURCES

Soil as a Natural Resource

Soil is defined as upper layer of the earth differentiated into various horizons and capable of supporting plant life. Land and its soils are considered as important resources of earth. Land as a resource it is essential for development of agriculture and forestry. Soil is one of the most important ecological factors. Plants depend for their nutrients, water supply, and anchorage upon the soil. Soil is actually formed as a result of long- term process of complex interactions leading to the production of mineral matrix in close association with interstitial organic matter-living as well as dead.

Soil has biological system of living organisms as well as some other components. It is preferred to call it a 'soil complex', which has the following five categories of components.

1. Mineral matter 2. Soil organic matter or humus 3. Soil solution or soil water

4. Soil atmosphere O2 and CO2 content not filled with water.

5. Biological system bacteria, fungi, algae, protozoa, etc.

Some important functions of soil are as under

- It provides mechanical support to the flora.
- Due to its porosity and water-holding capacity, the soil serves as a reservoir of water and supplies water to the plants (even when the land surface is dry).
- The ion-exchange capacity of soil ensures the availability and supply of micro-and macro-nutrients for the growth of plants, microbes and animals.
- Soil also helps in preventing excessive leaching of nutrient ions, while maintaining proper PH
- Soil contains a wide variety of bacteria (like nitrifying, nitrogen-fixing, organo trophic, etc.), fungi, protozoans, and many other microbes which help in the decomposition and mineralization of organic matter and regeneration of nutrients.

**Land Degradation**

Land degradation refers to deterioration or loss of fertility or productive capacity of the soil. Land resources are very much related to natural disasters like volcanic eruptions, earthquakes etc. but it is due to human activities that soil gets polluted. Land degraded by soil erosion, salination, water-logging, desertification, shifting cultivation, urbanization, landslides and soil pollution.

**A. SOIL EROSION**

The top layer of the soil contains nutrient required by the plants. This fertile top soil is most valuable natural resource, at a depth of 15 – 20

cm. The loss of top soil or disturbance of the soil structure is known as 'soil erosion'.

Types of soil erosion

a. Based on the rate of soil loss takes place, there are two main types

1. Normal or geologic erosion It occurs under normal, natural conditions by it-self without any interference of man. As natural, it is very slow process, unless there is some major disturbance by a foreign agent.

2. Accelerated soil erosion This type of removal of soil is very rapid and never keeps place with the soil formation. This is the serious type of loss, generally caused by an interference of an agency like man and other animals.

b.Agents of soil erosionBased on the various 'agents' that bring about soil erosion and the 'form' in which the soil is lost during erosion, there are following types-

a. Water erosion caused by the action of water, which removes the soil by falling on as 'rain drops', as well as by its 'surface flow' action.

b. Soil erosion Soil loss by wind is common in dry (arid) regions, where soil is chiefly sandy and the vegetation is very poor or even absent. High velocity winds blow away the soil particles.

c. Landslides or Slip erosion The hydraulic pressure caused by heavy rains increases the weight of the rocks at cliffs which come under gravitational force and finally slip or fall off. Sometimes entire hillock may slide down.

d. Stream bank erosion The River during floods splashes their water against the banks and thus cuts through them.

e. Deforestation & Over grazing Effects of deforestation and over grazing are well known on soil loss. In India annual loss of soil nutrients in this way is of the order of 5.37 million tons of N, P, K valued at about Rs.700 crores.

**B. Salination**

Salinationrefers to increase in the concentration of soluble salts in the soil. Poor drainage of irrigation and flood waters results in accumulation of dissolved salts on the soil surface. In arid and semi-arid areas with poor drainage and high temperatures, water evaporates quickly leaving behind a white crust of salts on the soil surface. The high concentration of salts in soil severely affects the water absorption process of the plants, resulting into poor productivity.

**C. Water logging**

Water logging may be due to surface flooding or due to high water table. Excessive use of canal irrigation may disturb the water balance and create water logging as a result of seepage or rise in the water table of the area. The productivity of water logged soil is severely affected reduce due to lesser availability of oxygen for the respiration of plants.

**D. Desertification**

Desertification is a slow process of land degradation that leads to desert formation. I is like a 'skin disease' over planet wherein patches of degraded land, eruption separately, gradually join together. For example, Thar Desert (India) was formed by the degradation of thousands of hectares of productive land. It may result either due to a natural phenomenon linked to climatic change or due to abusive use of land.Mismanagement of natural resources including land, certain irreversible changes has triggered the breakdown of nutrient cycles and micro climatic equilibrium in the soil indicating the ones of desert conditions.

**CAUSES OF DESERTIFICATION**

a. Deforestation The process of denuding and degrading a forested land initiates a desert producing cycle that feeds on itself. Since there is no vegetation to hold back the surface run-off, water drains off quickly before it can soak into the soil to nourish the plants or to replenish the groundwater. This increases soil erosion, loss of fertility and loss of water.

b. Over grazing This is because the increasing cattle population heavily grazes in grasslands or forests and as a result denudes the land area. The dry barren land becomes loose and more prone to soil erosion. The top fertile layer is also lost and thus plant growth is badly hampered in such soils.

c. Mining and QuarryingThese activities are also responsible for loss of vegetative cover and denudation of extensive land areas leading to desertification.

E. Shifting Cultivation Shifting (Jhum) cultivation, a very peculiar practice of slash and burn agriculture, prevalent among many tribal communities inhabiting the tropical and sub- tropical regions of Africa, Asia and Islands of Pacific Ocean has also laid large forest tracts bare. This practice has led to complete destruction of forests in many hilly areas of India, North-East and Orissa, and caused soil erosion and other associated problems of land degradation.

F. Urbanization Human activities are responsible for the land degradation of forests, croplands and grass lands. The productive areas are fast reducing because of urbanization i.e., the developmental activities such as human settlements and industries.

G. Landslides Human activities such as construction of road and railway, canal, dams and reservoir and mining in hilly areas have affected the stability of hill slopes and damaged the protective vegetation cover above and below roads and other such developmental works. This has upset the balance of nature, making such areas vulnerable to landslides.

H. Soil Pollution Industrial effluents contain high concentration of chemicals. For example Paper and Pulp industrial waste water contain organic matter, Soap industrial waste water contain fatty acids, fertilizer industrial waste water contain chemicals etc. these chemicals degrade the soil fertility and loss of microorganisms.

**CONTROL OF LAND DEGRADATION**

The process of soil formation is slow that soil can be considered as non-renewable resource. Therefore, control of land degradation is very important and can be achieved by taking the following measures

a) Afforestation and reforestation

a. Afforestation means growing forests where there were no forests before, may be due to lack of seed trees or adverse factors.

b. Reforestation means replanting forests at places where they were destroyed by overgrazing, excessive felling, forest fires etc. restoring forests helps to check soil erosion, floods and water logging.

b) Better Agricultural Practices

a. Terracing a large sloping drainage area is divided into a number of small distinctly separate flat fields called terraces. These slow down the speed of run-off water; hold the water longer on the land so that more of it is soaked into the land and this result in higher crop yields.

b. Regular Cultivation field should not be left bare and there should be regular cultivation of the fields with a vegetation cover so that erosion is checked and maximum water in filters into the soil due to minimum run-off of water.

c. Crop Rotation this involves sowing of different crops in the same field in a regular sequence for a number of years.

d. Fallowing aeration, texture and fertility of soil can be improved by ploughing the fields extensively and then leaving them without sowing for a year or two.

c) Planting Wind Breaks and Shelter Belts

To check the velocity of wind, two or more rows of tall trees are planted at right angles to the direction of the prevailing winds. These wind breaks check the movements of wind and therefore check soil erosion.

## 2.7 FOREST RESOURCES

A forest is a biotic community which is predominantly composed of trees, shrubs or any woody vegetation and often with a closed canopy (over-hanging covering). Approximately one third of the earth's total land area is covered by forests. Forests and wildlife are essential for ecological balance of an area. Forests are important components of our

environment and economy. Forest ecosystem is dominated by trees, their species content varying in different parts of the world.

Forests have following three types of functions

1) Productive functions The productive functions of forests include the production of Timber- for furniture items, Wood- which is used as fuel, raw material for various industries as paper and pulp Industries, news-print, board and packing articles (for fruit, tea etc.), matches, sports goods etc. Indian forests also supply minor forest products- like canes, gums, resins, dyes, tannins, lac, fibers, flocks, medicines, Kath etc. Tribal people forests also provide food (tuber, roots, leaves, fruits, meat from birds and other animals) and Medicare.

2) Protective functions These functions include conservation of soil and water, prevention of drought and protection against wind, cold, radiation, noise, sights and smells, etc.

3) Regulative functions Forests are a major factor of environmental concern, providing protection to wildlife, help in balancing the gaseous (CO2, O2) cycles of atmosphere, tend to increase local rainfall and water holding capacity of soil, maintain the soil fertility, regulate the earth's temperature, water cycles, check soil erosion, land slides, shifting of sand and silting and reduce flood havoc.

**Over- exploitation**

Human beings have depend 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. shooted up resulting 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 (forest destruction)**

Total forest area of the world in 1900 was nearly 7000 M.ha. By 1975 it was reduced to 2890 M.ha. By 2005 it was reduced to 2370 M.ha. and if continues like this by 2015 it would be merely 2000 M.ha. Destruction of biotic potential of land leads to desertification. Such problem arises due

to over grazing, indiscriminate felling of trees and over exploitation of land resources.

The disadvantaging effects of deforestation in India include soil, water and wind erosions, estimated to cost over 16,400 crores every year.

Deforestation has a major impact on the productivity of our croplands. This happens in two ways-

1. Soil erosion increases manifold and the soil actually gets washed, leading to an accentuated cycle of floods and drought.

2. But equally important is the impact of the shortage of firewood on the productivity of our croplands.

Causes of deforestation

- Forests destroyed for growing demand of the cities.

- Local cattle, goats, sheep etc. destroy the vegetation.

- Shivalik sal forests were over exploited for industrial use (railway sleepers etc.)

- Demand of fuel wood and timber due to increase population.

- Construction of roads, railways, houses, dams and power stations.

- The faulty planning of Govt. and its negligence towards forests.

- The green house effect.

**Effects of deforestation**

Deforestation affects human life in several ways. The main effects of deforestation are as follows

1. Forests, particularly on mountains, provide considerable protection from floods by trapping and absorbing precipitation (i.e rain, snow etc) and slowly releasing it later. When the forest is removes, the amount of runoff water flowing into rivers and streams increases several fold causing frequent floods.

2. Deforestation results in increased soil erosion and decreased soil fertility. In drier areas, deforestation can lead to the formation of deserts. on an average India is losing about 6,000 million tons of top soil annually due to water erosion in the absence of trees.

3. Deforestation causes the extinction of forests dwelling plant, animal and microbial species resulting into a loss if irreplaceable genetic resources.

4. Deforestation also threats indigenous (tribal) people whose culture and physical survival depend upon the forests.

5. Deforestation induces regional and global climate change. The climate has become warmer due to lack of humidity in the deforested regions.

6. The pattern of rainfall has changed in deforested areas. The rainfall has declined and droughts have become common.

7. Deforestation also contributes to global warming stored carbon into the atmosphere as CO2, which is a greenhouse gas.

8. Human beings are deprived of benefits of forest trees and wild animals.

Timber and Wood

Total world wood consumption is about 360 million tons i.e. about 360 million m3/ year, more than steel and plastics together, weight- wise commercial timber and round wood (unprocessed logs) are used to make lumbers, plywood, veneer, particle board and chip board. Approximately 15 crore people depend only on fuel wood for their energy. Average quantity of wood requirement in the world is 1 m3/year/person for cooking and heating.

*China suffered a lot from erosion and floods as it has cut millions of trees 1000 years ago. However, 4.5 million hectares/ year were planted between 1983 – 1993.

Effects of timber extraction

There has been unlimited exploitation of timber for commercial use. Commercial/industrial demand could out-strip supply leading to decimation of forests, particularly the wood. The major effects of timber extraction on forests and tribal people include

* poor logging results in a degraded forests.

* soil erosion, especially on slopes.

* sedimentation of irrigation systems.

* floods may be intensified by cutting of trees on upstream watersheds.

* loss of biodiversity.

* climatic changes, such as lower precipitation.

* new logging roads permit shifting cultivators and fuel wood gatherers to gain access to logged areas and fell the remaining trees.

* loss of non-timber products and loss of long-term forest productivity on the site affect the subsistence economy of the forest dwellers.

* forest fragmentation, the reduction of a large block of forest to many smaller tracts, promotes loss of biodiversity because some species of plants and animals require large continuous areas of similar habitat to survive.

* species of plants and animals, which may occupy marrow ecological niches and whose potential value to humans is unknown, may be eliminated.

* indigenous people may be forced into a new way of life for which they are unprepared.

* exploitation of tribal people by the contractors.

* cutting of more trees than permitted in a particular area by the greedy contractors.

## 2.8 ENERGY RESOURCES

### Growing energy needs

Energy is an important input for development. It aims at human welfare covering household, agriculture, transport and industrial complexes. The rapidly expanding human population, human energy needs are increasing rapidly. It will demand the exploitation of most energy sources. Like other natural resources, energy resources are also non-renewable as well as renewable.

India's per capita energy consumption today, at 350 KWH per annum, is one tenth of world's average and one fourteenth of U.S. average. The energy consumption is concentrated in the urban sector covering 30% of the country's population.

For example- an electric bulb uses 100 watts of energy,A color T.V. uses 200 watts,A car uses about 30,000 watts.

Thousands of years ago people had only sun's energy and their own energy. They burnt wood for heat, used animals for pulling. Surely we'll be going to those days again, steadily and surely.

The domestic power consumption has the following pattern of percentages

| S.No. | Purpose | Urban | Rural |
|---|---|---|---|
| 1 | Lighting by Kerosene | 45.2 | 84.0 |
| 2 | Lighting by electricity | 53.0 | - |
| 3 | Cooking by non-commercial fuel | 58.1 | 4.5 |
| 4 | Cooking by Kerosene | 26.5 | - |

The present electric power generating capacity of 105W if facing a 20% deficit to meet the demand.

The world consumes energy in the following fashion.

Petroleum products = 39%, Natural gas = 24%, Coal = 32%, Tidal Power = 2.5%, Nuclear power = 2.5%.

**Types of Energy Resources**

1. Non- renewable Energy Resources

These are exhaustible resources and available in limited amount and develop over a longer period. These include-

a. Fossil fuels like coal, petroleum, natural gas and mineral oil. Coal, petroleum and natural gas, the common sources of energy, being organic (biotic) in their origin are also called 'fossil fuels'. Fossil fuels contribute 60% of the present power generation.

i) Coal Coal is the first fossil fuel to be exploited on a large scale; so industrial revolution enabled coal to be mined at even greater depths.

Types of coal

a) Peat contains 5% of carbon, 5% of volatile matter and 90% moisture. It is having low calorific value. It is generally in dry condition.

b) Lignite is the lowest form of coal. It is brown in color. Hence it is called as brown coal. Pure lignite is mined at Neyveli, Tamilnadu. It has 38% of carbon, 19% of volatile matter and 43% of moisture.

c) Bituminous coal is also called soft coal. It contains 3% of water. It is highly flammable. It has 65% of carbon, and 32% of volatile matter.

d) Anthracite is a hard and dense coal. This type of coal contains 96% of carbon, 1% of volatile matter and 3% of moisture. It has the highest energy content of all coals and is used for space heating and generating electricity.

ii) Oil or Petroleum Petroleum is an inflammable liquid composed of hydrocarbons, which constitute the majority and the remainder is organic compounds like O2, N2, S and traces of organic-metallic

compounds. It is pumped to the surface as crude oil and refined to get desired products.

**Distillation**

Heated crude oil ----------□ Fuel gas, Propane, Butane, liquefied gas

□ Gasoline

□ Kerosene

□ Furnace oil

□ Diesel

□ Lubricants

□ Asphalt

**Petroleum fractionation process**

As a source of energy petroleum has many advantages

□ it is relatively cheap to extract and transport

□ it requires little processing to produce desired products and

□ It has relatively high net and useful energy yield. However it has certain disadvantages also,

□ Produces environmental pollution.

□ Oil spills, in ocean cause water pollution and is expensive to clean up.

iii) Petroleum gas It is the mixture of three hydrocarbons such as butane, propane and ethane. The main constituent of petroleum gas is butane. These are in gaseous state, which is liquefied under pressure. So it is called as LPG. A domestic cylinder contains 14kg of LPG. A strong smelling substance called ethyl mercaptane is added to LPG cylinder to help in the detection of gas leakage.

iv) Natural gas It consists of methane with small quantities of ethane and propane. It is available in deep under crust. Natural gas is a by-product to petroleum mining. It meets about 24% of the world's energy requirement. In our country few natural gas fields have been discovered recently in Tripura, shore area of Bombay and in the Krishna, Godavari delta.

b. Nuclear fuels around 2.8 % of the power generation at present is atomic power with 10,000 MW. Radioactive materials like Uranium, Thorium, Radium etc. metals are used for production of energy by fission and fusion process.

Energy is generated from uranium for the peaceful work. 1kg of Uranium liberates an energy equivalent to 35000kg of coal. Nuclear energy is used for generation of electricity and used to running submarines, warships, space-crafts etc.

The first nuclear reactor was started in USA on Dec 2, 1942. Today almost all countries have atomic reactors for power generation. In France, 73% of the commercial energy is provided by atomic reactors. There are several types of nuclear reactors, these are

i) Light Water Reactor (LWR) ii) Heavy Water Reactor (HWR)

iii) Gas Cooled Reactor (GCR) iv) Boiling Water Reactor (BWR)

v) Pressurized Water Reactor (PWR)vi) Liquid Metal Fast Breeder Reactor (LMFBR).

## 2.9 RENEWABLE ENERGY RESOURCES

These are mostly biomass based and available in unlimited amount in nature. These are inexhaustible materials. These include-

a. Hydro energy Large amount of kinetic energy of the flowing water is tapped using water turbines. A hydro power project involves construction of Dams. Currently 20% of the world's energy demand is produced in the form of hydro-energy. India is tapping about 84000MW through hydel potential. Totally, 271 projects have been installed in India. Advantages of Hydro power- clean source of energy, provides irrigation facilities, provides drinking water to the people living around.

b. Wind energy Wind forms in two major ways in the atmosphere.

- Unequal distribution of temperature, pressure on earth surface.
- Continuous rotation of earth.

Wind mills have a good potential as an energy source, particularly in rural areas. The mobilization of this resource at present is negligible. Most important advantages of wind energy is – a perennial sources, available all the day and night, eco-friendly, non-polluting and freely available.

c. Solar energy The sunshine in India supplies 1600 to 200 Kw per sq. m per year. Photovoltaic cell technology can hold a good promise for realizing the solar energy available in India. Presently it used to power satellites, watches, calculating devices etc. Following are some of applications of solar energy directly useful to the human beings- solar water heaters, solar cookers, solar drier, solar refrigerator.

d. Biomass the matter originating directly or indirectly from photosynthesis is called biomass. Plant matter, bio degradable organic wastes, combustible waste residues etc constitute the biomass that can release heat energy on chemical/ biochemical oxidation.

Wood as fuel (amounting to 68.5%), oil products (15.6%), animal dung (8.3%) etc. are the biomass energy sources in the Indian rural area.

e. Bio gas With 240 million cattle, India is the largest cattle dung producer. This material has a good potential to yield (methane) fuel gas under an anaerobic decomposition.

The composition of bio gas -CH4 50 to 55%, CO2 25 to 35%, O2 6 to 8%, Other gases 7 to 15% Over 1,50,000 bio gas plants are in operation today in our country.

f. Animal energy Animal energy consumed in the agricultural sector of our country, employing 70 million bullocks, 8 million buffaloes, 1 million horses and 1 million camels in addition to donkeys, elephants. This animal power amounts to 30,000 MW as against 40,000 MW of total electrical energy capacity today.

g. Geothermal energy The earth is having large amount geothermal energy with a higher temperature that is 45000C. The energy comes from the molten rock material beneath the earth surface. The available thermal energy is used to produce power by running a smaller capacity thermal power plant.

h. Tidal energy Tides, the alternate rise and fall of sea water possess lot of energy. The identified tidal power potential in India is around 9000 MW. Currently Russia, China and Canada are effectively utilizing the tidal energy to produce 2 to 3% of their energy demand.

## 2.10 ALTERNATIVE ENERGY SOURCES

1. Petro plants The hydrocarbons present in such plants can be converted into petroleum hydrocarbons. The plants belong to Euphorbiacea, Asclepiadacea, Apocynaceae and Sapotaceae and over 385 species have been screened for hydrocarbon content. 15 species around promising.

The Indian Institute of Petroleum, Dehra Dun has done excellent work in this area. Particularly in hydro cracking of the crude products. The products obtained from their latex processed bio crude were gases, naphtha, kerosene, gas oil, heavier,coke.

2. Dendro thermal energy (Energy plantations) Waste lands are being used for plantation of fast growing shrubs and trees with high Calorific value. They in turn provide fuel wood, charcoal, fodder, power.

3. Energy from urban waste Sewage in cities is used for generating gas and electricity.

4. Bagasse-based plants Bagesse, a waste of sugar mills can be used to generate energy. It is estimated that sugar mills in India can generate 2,000 MW surplus electricity during crushing season.

# CHAPTER 3

# BIODIVERSITY AND BIOTIC RESOURCES

## 3.1 INTRODUCTION

Biodiversity refers to the variety of life on Earth, including the diversity of species, ecosystems, and genetic variation within species. Biodiversity is essential to the functioning of ecosystems, providing a range of ecosystem services such as pollination, nutrient cycling, and climate regulation. It is also important for human well-being, as it provides food, medicine, and other resources.

Biodiversity can be measured at different levels, from genetic diversity within a species to the variety of species in a particular ecosystem or across the entire planet. Biodiversity is threatened by human activities such as habitat destruction, pollution, overexploitation of resources, and climate change. Conservation efforts aim to protect and restore biodiversity, often through the creation of protected areas and the implementation of sustainable management practices.

Biodiversity includes the different

1. Types of animals, birds, fish, insects, bacteria, and other species.
2. Ways in which species interact with their environment.
3. Ways species live together.
4. Types of places species live together.
5. Characteristic within a species.

## 3.2 SIGNIFICANCE OF BIODIVERSITY

Biodiversity, the variety of life on Earth, is essential for the survival of all living organisms. Biodiversity provides many ecological, economic, and social benefits, and its significance can be summarized as follows:

1. Ecological significance: Biodiversity plays a critical role in maintaining the health and balance of ecosystems. It helps to maintain essential

ecological processes such as nutrient cycling, pollination, and seed dispersal, which are necessary for the survival of ecosystems and the services they provide.

2. Economic significance: Biodiversity provides a wide range of goods and services that are critical to the economy. These include food, fiber, timber, medicines, and tourism. Biodiversity also provides natural resources for industries such as agriculture, forestry, and fisheries.

3. Social significance: Biodiversity is important for cultural, spiritual, and recreational purposes. Many communities rely on biodiversity for their livelihoods, and it is often an essential component of their cultural identity. Biodiversity also provides opportunities for recreation and ecotourism, which can have significant economic benefits.

4. Scientific significance: Biodiversity provides a vast array of biological resources that are used in scientific research. These resources help scientists to understand the fundamental principles of life and how ecosystems function. Biodiversity also provides a source of inspiration for biomimicry, where human-made designs are based on natural systems.

5. Existential significance: Biodiversity is essential for the survival of all life on Earth, including humans. It provides ecosystem services such as clean air, water, and soil that are necessary for our survival. Biodiversity also plays a crucial role in regulating the Earth's climate and maintaining the planet's overall health and stability.

Overall, the significance of biodiversity cannot be overstated, and it is essential that we work to conserve and protect it for the benefit of current and future generations.

## 3.3 TYPES OF BIODIVERSITY

Biodiversity is generally classified classified into three types

**Genetic diversity**

**Species Diversity**

**Ecosystem or Community Diversity.**

- **Genetic Diversity**

Genetic diversity refers to the variation of genes within species. Genes are the basic units of all life on Earth. They are responsible for both the similarities and differences between organisms. Each species is made up of individuals that have their own particular genetic composition. This means a species may have different populations of species compositions to conserve genetic diversity, different populations of species must be conserved. This type of diversity occurs at finer levels of organisms. Genetic diversity can be measured using a variety of DNA based and other techniques.

**2. Species Diversity**

Species diversity is the number of different species of living things available in an area. Species is a group of plants or animals that are similar and able to breed and produce viable offspring under natural conditions. This type of diversity is the most common level of diversity. It is measured in relation to a given area.

**3. Ecosystem Diversity**

Ecosystem diversity is the variety of ecosystems in given place. An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem can cover a large area, such as a whole forest, or a small area, such as a pond. This type of diversity is considered as a complex level of diversity.

## 3.4 VALUES OF BIODIVERSITY

The value of bio diversity is classified into the following two types

**Direct values** and

**Indirect values**

**1. Direct values** These are assigned to the products harvested by people, Direct values can be further divided as follows

**a. *Consumptive use value*** This can be assigned to goods such as fuel wood and gum that are consumed locally and do not figure in national and international market.eg. Firewood, food, meat.

**b**. ***Productive use value*** This is assigned to products that are harvested from the wild and sold in commercial markets, both at national and international levels. e.g timber, fish, honey, construction material, mushrooms, fruits, meat, medicinal plants etc.

**2. Indirect Values** these are assigned to benefits provided by biodiversity that do not involve harvesting or destroying the resource without consumption of resource. Such benefits include water quality, soil protection, recreation, education, scientific research, regulation of climatic and producing further options for human society. Indirect values further divided into-

**A. Social Values**It refers to the manner in which the bio-resources are used to the society. These values are associated with the social life, religion and spiritual aspects of the people.

e.g. Holy plants tulsi, peepal, lotus, betal these are used in worship.

Holy animals cow, snake, bull, peacock, rats, etc., are used in worship.

**B. Ethical Values or Existence Values**

It involves ethical issues like “all life must be preserved”. In India and in other countries biodiversity is considered to have great value on religious and cultural basis. It teaches us to worship plants, animals, rivers and mountains. The ethical values mean that a species may or may not be used, but its existence in nature gives us pleasure.

E.g. Holy River Ganga, holy plants vembu, tulsi, kangaroo, zebra or giraffe feel that these should exist in nature.

**C. Aesthetic Values**

The beautiful nature of plants and animals insist us to protect the biodiversity. The most important aesthetic value of biodiversity is eco-tourism.

e.g., eco-tourism people spend lot of time and money to visit the beautiful areas and enjoy the aesthetic value of biodiversity. Wild birds, animals, butterflies, flowers, valleys etc.

**D. Intrinsic Values**

It implies conservation of biodiversity and the need to facilitate continued evaluation. Humans should protect biodiversity because protection of the environment is morally good.

**E. Environmental Services** Protection of water resources, soil formation and protection, nutrient storage and cycling, pollution breakdown and absorption, contribution to climate stability, maintenance of ecosystem.

## 3.5 BIO GEOGRAPHICAL CLASSIFICATION OF INDIA

One of the major approaches to the classification of India's ecosystems has been based on biogeography. The major objective of this bio geographical classification based on scientific facts is to enable conservation planning, both at the national and state levels. The biogeographical classification uses four levels of planning units which are listed below

***The Biogeographic Zone*** it is a large distinctive unit of similar ecology, biome representation, community and species. E.g. the Himalaya, the Western Ghats.

***The Biotic Province*** It is Secondary in units within a biogeographic zone, giving weight to particular community separated by dispersal barriers or gradual change in environmental factors e.g. North West and Western Himalayas either side of Sutlej River.

***The Land Region*** It is tertiary set of units within a province, indicating different land forms.

E.g., Aravalli Mountains and Malwa Plateanu in Gujarat-Rajwara Province.

***The Biome*** It is an ecological unit, not a biogeographic unit. A biome such as swamp/wetland of temperate broad leaved forest could be found in several biogeographic zones or provinces.

India is classified into 10 Biogeographic Zones and is further divided into 26 Biotic Provinces. The Indian

| Zone no. | Zone name | Provinces | Zone area km² | % of India |
|---|---|---|---|---|
| 1 | Trans-Himalaya | 2 | 184823 | 5.62 |
| 2 | Himalaya | 4 | 210662 | 6.41 |
| 3 | Desert | 2 | 215757 | 6.56 |
| 4 | Semi-arid | 2 | 545850 | 16.6 |
| 5 | Western ghats | 2 | 132606 | 4.03 |
| 6 | Deccan Peninsula | 5 | 1380380 | 41.99 |
| 7 | Gangetic Plain | 2 | 354782 | 10.79 |
| 8 | Coasts | 3 | 82813 | 2.52 |
| 9 | North East | 2 | 171341 | 5.21 |
| 10 | Island | 2 | 8249 | 0.25 |
| | Grand Total | 26 | 3287263 | 100.00 |

**India as a Mega-diversity Nation**

India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. India contains about 8% of the world's biodiversity on 2% of the Earth's surface, making it one of the 12 mega diversity countries in the world. This is based on the species

richness and levels of endemism recorded in a wide range of taxa of both plant and animals. This diversity can be attributed to the vast variety of landforms and climates resulting in habitats ranging from tropical to temperate, and from alpine to desert. Adding to this is very high diversity of human influenced ecosystems, including agricultural and pasturelands and an impressive range of domesticated plants and animals. India is also considered one of the world's eight centers of origin of cultivated plants. India has got 12 biosphere reserves and 5 world heritage sites.

India due to its varied physical features and its geographical location, experience almost all kinds of climate, from tropical to alpine and from desert to humid. On the basis of temperature the landmass of India is classified into four zones

***1 Tropical zone*** This is very hot round the year and does not have a winter.

***2 Subtropical zone*** This is hot for the year and with a cool winter.

***3 Temperate zone*** This has a short summer and a pronounced winter.

**4. Arctic or Alpine zone** This has a short summer and a long and severe winter.

The following is a list of important facts about the Indian biodiversity

ii. India is a home to 33% of life forms found in the world and is one among the 12 mega diverse countries of the world.

iii. India comprises 2% of the world's landmass but is home to 8% of biodiversity of the world.

iv. India can be divided into 10 biogeographic zones and 26 biotic provinces, which represents all the major ecosystem of the world.

v. There are 33 Botanical Gardens, 89 national parks, 275 zoos, 504 sanctuaries and 12 biosphere reserves in India.

vi. There are 47000 species of plants and 81000 species of animals identified in the country.

 60% of this wealth can be found in the Western Ghats, which is one of the hotspots of diversity in India.

a. Of 81,000 species of animals recorded 372 are mammals, 1228 are birds, 428 reptiles, 204 amphibians, 2536 fishes, 57,245 insects, 5042 mollusks and several other species of invertebrates.

b. India is a signatory to the international conventions like Convention of International Trade on Endangered Species and Convention of Migratory Species which aim at conserving biodiversity.

c. India is home to 5 world heritage sites and 6 Ramsar wetlands, amongst the protected areas.

(Kaziranga National Park, Keoladeo Ghana National Park, Manas Wildlife Sanctuary, Nanda Devi National Park, Sundarban National Park).

## 3.6 HOT SPOTS OF BIODIVERSITY

Hot spots of biodiversity refer to areas that have a high level of biodiversity and a large number of endemic species, meaning species that are found nowhere else in the world. These hot spots are typically threatened by human activity, such as deforestation, overfishing, and climate change, which puts the unique species living there at risk of extinction.

One example of a hot spot of biodiversity is the Amazon rainforest, which covers much of northern South America and is home to a staggering variety of plant and animal species. The Coral Triangle, which spans the waters of several Southeast Asian countries, is another important hot spot, known for its diverse marine life, including many species of fish, sharks, and sea turtles.

Other hot spots include the Cape Floristic Region in South Africa, the Mediterranean Basin, and the Eastern Himalayas, among many others. The conservation of these areas is important not only for their unique species, but also for the ecological services they provide, such as carbon sequestration, clean water, and air purification.

To qualify as a hotspot a region must satisfy the following conditions.

ii. Must support 1500 endemic plant species, 0.5% of global total. Existing primary vegetation is the basis for assessing human impact in a region;

iii. Must have lost more than 70% of its original habitat.

Plants have been used as qualifiers because they are the basis for diversity in other taxonomic groups and are well known to researchers. Typically, the diversity of endemic vertebrates in hotspot regions is also extraordinarily high. Thus hotspots are extremely rich in species, have high endemism, and are under constant threat.

The hotspot concept targets regions where the threat is greatest to the number of species and allows conservationists to focus cost effective efforts there. The 25 biodiversity hotspots of the world' contain 44%of all plant species and 35% of all terrestrial vertebrate species in only 1.4% of the planet's land area.

World hotspots list

| | | |
|---|---|---|
| 1. Tropical Andes. | 2. Mesoamerica | 3. Caribbean |
| 4. Brazil's Atlantic forest | 5. Choc.Darien/Western Ecuador | 6. Brazil's Cerrado |
| 7. Central Chile | 8. California Floristic Province | 9. Madagascar |
| 10. Eastern Arc and Tanzania/Kenya | Costal forests of | 11. Western African Forests |
| 12. Cape Floristic Province | 13. Succulent Karoo | 14. Mediterranean Basin |
| 15. Caucasus | 16. Sundaland | 17. Wallace a |
| 18. Philippines | 19. Indo-Burma | 20. South Central China |
| 21. Western Ghats | 22. SW Australia | 23. New Caledonia |

New
24. Zealand 25. Polynesia/Micronesia.

## 3.7 HOTSPOTS OF INDIA

India is one of the world's 17 megadiverse countries, with a rich and diverse array of flora and fauna. The country has a total of 10 biogeographic zones, each with its own unique characteristics, and is home to over 45,000 plant species and 91,000 animal species, including tigers, elephants, rhinoceroses, and many more.

The term "biodiversity hotspot" refers to a geographic area with significant levels of biodiversity and a large number of endemic species that are under threat from human activities. India has two recognized biodiversity hotspots: the Western Ghats and the Eastern Himalayas.

1. Western Ghats: The Western Ghats is a mountain range that runs along the western coast of India, covering a total area of 160,000 square kilometers. It is home to an incredible array of plant and animal species, many of which are found nowhere else on earth. The region is home to over 5,000 flowering plant species, 139 mammal species, 508 bird species, and 179 amphibian species, many of which are endemic. The Western Ghats is under threat from human activities such as deforestation, mining, and dam construction.

2. Eastern Himalayas: The Eastern Himalayas span across Bhutan, Nepal, and India, covering an area of approximately 200,000 square kilometers. The region is home to an incredible array of biodiversity, including over 10,000 plant species, 300 mammal species, and 977 bird species. The Eastern Himalayas is also home to a number of endemic species, such as the red panda and the Himalayan quail. The region is under threat from human activities such as deforestation, mining, and climate change.

Protecting these biodiversity hotspots is crucial to preserving India's rich natural heritage and the world's overall biodiversity. Conservation efforts should focus on reducing human impact and protecting critical habitats for endangered species.

## 3.8 MAJOR THREATS TO BIODIVERSITY

Any disturbance in a natural ecosystem tends to reduce its biodiversity. The waste generated due to increase in human population and industrialization, spoils the environment and leads to more diversity in biological species. Any change in the system leads to a major imbalance and threatens the normal ecological cycle. Causes for biodiversity or various threats to Indian biodiversity

1. Habitat Loss

2. Poaching of wild life.

3. Man-wildlife Conflicts.

### 1. HABITAT LOSS

The loss of populations of interbreeding organisms is caused by habitat loss. Habitat loss threatened a side rang of animals and plants. Factors influencing habitat loss are

1. ***Deforestation*** forest and grasslands have been cleared for conversion into agricultural lands or settlement areas or developmental project. The forest and grasslands are the natural homes of thousands of species, which disintegrate due to loss of their natural habitat.

2. ***Destruction of wetlands*** the wetlands, estuaries and mangroves are destroyed due to draining, filling and pollution, which cause huge biodiversity loss.

3. ***Habitat Fragmentation*** it is process of division of population into number of small and smaller groups. These small populations are increasingly susceptible to inbreeding depression, high infant mortality and susceptible to environmental stochasticity and consequently in the end possible extinction.

4. ***Raw material*** for the production of hybrid seed, the wild plants are used as raw materials. As a result many plant species become extinct.

5. ***Production of Drugs*** many pharmaceutical companies collect wild plant for the production of drugs. Therefore several medicinal plant species are on the verge of extinction.

6. ***Illegal Trade*** illegal trade on wild life also reduces the biodiversity and leads to habitat loss.

7. ***Development Activities*** construction of massive dams in forest area, discharge of industrial effluents kills the birds and other aquatic organisms.

8. ***Diseases*** Pathogens, or disease organisms, may also be considered predators. The incidence of disease in wild species may increase due to human activities.

9. ***Pollution*** Environmental pollution is the most harmful to habitat degradation. Most common causes[5] of which are pesticides, industrial effluents and emissions, and emission from automobiles.

***Introduction of exotic species*** Organisms introduced into habitats where they are not native are termed as exotic. They can be thought of as biological pollutants and are considered to be among the most damaging agents of habitat alteration and degradation.

## 2. POACHING OF WILDLIFE

Poaching means killing of animals or commercial hunting. It leads to loss of animal diversity.

a. ***Subsistence Poaching*** it is killing animals to provide enough food for their survival.

b. ***Commercial Poaching*** it is hunting and killing animals to sell their products. E.g. Furs, horns, tasks, live specimens, herbal products, ivory, and meat.

## 3. MAN-WILDLIFE CONFLICTS

It arises when wildlife starts causing immense damage and danger to man. Under such conditions it is very difficult for the forest department

to compromise the affected villagers and to gain the villagers support for wildlife conservation. Factors influences conflicts are

1. Shrinking of forest cover compels wildlife to move outside the forest and attack the field and humans for food.

2. Human encroachment into the forest area.

3. Injured animals, female wildlife attack humans.

4. Electrification of crop field from wildlife.

5. Cash compensation paid by govt. is less than the damage which makes farmers anger and takes revenge by killing them.

6. Garbage or food crop near forest areas attacks wild animals.

## 3.9 BIODIVERSITY CONSERVATION

In order to retain the capabilities of life supporting systems it is essential to save and maintain species and ecosystems ultimately for survival of human race. Efforts have been made to save biodiversity both by ex-situ and in-situ conservation.

1. Ex-situ conservation it refers to conservation of species in suitable locations outside their natural habitat. The need to conserve species in ex-situ arise when its population is so fragile/fragmented that its survival in wild may no longer be possible or in other words a threatened or endangered species. e.g Botanical/Zoological gardens, aquarium and research centers, Field Gene Banks(pollen, semen, ova, cells), Seed Banks, In Vitro(in Grass meristem tips, buds and stem tips kept under low temp. for slow growth for longer storage).

2. In-situ conservation the preservation of species in its natural ecosystem is called in-situ conservation.

It is being done by declaring the area as 'protected area' with either to save the entire area or an endangered species. As a consequence, protected area are being identified and maintained for natural conservation of species by individual countries in the world. Protecting the areas helps not only in conserving individual species but preserves

Ecosystem also. In these protected areas – tourism, explosive activities, poaching, shooting, grazing of domestic animals, cutting of trees are strictly prohibited. We have protected area network of Biosphere, National park and Sanctuaries etc.

**Steps for Conservation of Biodiversity**

1. Biodiversity inventories and assessments – population surveys and assessments – population surveys and assessment.

2. Identifying and expanding protected areas.

3. Conserving biodiversity in seed banks and gene banks.

4. Controlling wild life trade.

5. Providing environmental education to the people.

6. Reviewing agricultural practices.

7. Controlling urbanization.

8. Geographical information system for planning and monitoring.

9. Restoration of biodiversity.

10. Population control.6

11. Implementing environmental protection Act (EPA).

12. Involving more non-government organizations (NGOs).

**Case Studies**

**1. Kesterson Wildlife Refuge** In 1983, biologists discovered birth defects in water birds born in the Kesterson wildlife Refuge in California. These defects were due to high concentration of 'selenium'. The selenium and other salts was carried into the refuge in the irrigation water flowing from the irrigation canal. According to plan, the saline water was transported by the drainage canal into the wildlife refuge for two purposes – to provide a wetland habitat for waterfowl and to dispose of the excess water. An unplanned effect was the buildup in selenium.

**2. Lake Apopka, Florida** A dramatic decline in alligators in 1980s in Florida's LakeApopka was one of the first examples of hormone disrupting chemicals (DDT) in the environment. The surveys showed that 90% of the alligator eggs laid each year were infertile and that of the few that hatched only about half survived more than two weeks. Male hatchlings had shrunken penises and had unusually low levels of the male

hormone testosterone. While female alligators has highly elevated estrogen levels and abnormal ovaries.

**3. DDT and Fragile Eggshells** During 1960s, several predatory bird species including bald eagles, peregrine falcons, osprey and brown pelicans suddenly disappeared from territories in eastern North America. Studies carried out by biologists revealed that eggs laid down by these predatory birds had thin, fragile shells that broke before hatching. These reproductive failures were traced to residues of DDT and its degradation product DDE, which had concentrated through food webs until reaching toxic concentrations in top trophic levels of these birds.

## 3.10 NATIONAL BIODIVERSITY ACT

NATIONAL BIODIVERSITY AUTHORITY Establishment of National Biodiversity Authority

(1) With effect from such date as the Central Government may, by notification in the Official Gazette, appoint, there shall be established by the Central Government for the purposes of this Act, a body to be called the National Biodiversity Authority.

(2) The National Biodiversity Authority shall be a body corporate by the name aforesaid, having perpetual succession and a common seal, with power to acquire, hold and dispose of property, both movable and immovable, and to contract, and shall by the said name sue and be sued.

(3) The head office of the National Biodiversity Authority shall be at Chennai and the National Biodiversity Authority may, with the previous approval of the Central Government, establish offices at other places in India.

(4) The National Biodiversity Authority shall consist of the following members,

a. a Chairperson, who shall be an eminent person having adequate knowledge and experience in the conservation and sustainable use of biological diversity and in matters relating to equitable sharing of benefits, to be appointed by the Central Government;

b. three ex officio members to be appointed by the Central Government, one representing the Ministry dealing with Tribal Affairs and two representing the Ministry dealing with Environment and Forests of whom one shall be the Additional Director General of Forests or the Director General of Forests;

c. seven ex officio members to be appointed by the Central Government to represent respectively the Ministries of the Central Government dealing with - i. Agricultural Research and Education; ii. Biotechnology; iii. Ocean Development; iv. Agriculture and Cooperation; v. Indian Systems of Medicine and Homeopathy; vi. Science and Technology; vii. Scientific and Industrial Research;

d. five non-official members to be appointed from amongst specialists and scientists having special knowledge of, or experience in, matters relating to conservation of biological diversity, sustainable use of biological resources and equitable sharing of benefits arising out of the use of biological resources, representatives of industry, conservers, creators and knowledge holders of biological resources. Conditions of service of Chairperson and members

9. The term of office and conditions of service of the Chairperson and the other members other than ex officio members of the National Biodiversity Authority shall be such as may be prescribed by the Central Government. Chairperson to be Chief Executive of National Biodiversity Authority

10. The Chairperson shall be the Chief Executive of the National Biodiversity Authority and shall exercise such powers and perform such duties, as may be prescribed. Removal of members

11. The Central Government may remove from the National Biodiversity Authority any member who, in its opinion, hasa. been adjudged as an insolvent; or b. been convicted of an offence which involves moral turpitude; or c. become physically or mentally incapable of acting as a member; or d. so abused his position as to render his continuance in office detrimental to the public interest; or e. acquired such financial or other interest as is likely to affect prejudicially his functions as a member. Meetings of National Biodiversity Authority.

## 3.11 FUNCTIONS AND POWERS OF THE NATIONAL BIODIVERSITY AUTHORITY

Functions and powers of National Biodiversity Authority 18. (1) It shall be the duty of the National Biodiversity Authority to regulate activities referred to in sections 3, 4 and 6 and by regulations issue guidelines for access to biological resources and for fair and equitable benefit sharing. (2) The National Biodiversity Authority may grant approval for undertaking any activity referred to in sections 3, 4 and 6. (3) The National Biodiversity Authority maya. advise the Central Government on matters relating to the conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising out of the utilization of biological resources; b. advise the State Governments in the selection of areas of biodiversity importance to be notified under sub-section (1) of section 37 as heritage sites and measures for the management of such heritage sites; c. perform such other functions as may be necessary to carry out the provisions of this Act. (4) The National Biodiversity Authority may, on behalf of the Central Government, take any measures necessary to oppose the grant of intellectual property rights in any country outside India on any biological resource obtained from India or knowledge associated with such biological resource which is derived from India

**Forests have following three types of functions**

1) **Productive functions** The productive functions of forests include the production of Timber- for furniture items, Wood- which is used as fuel, raw material for various industries as paper and pulp Industries, news print, board and packing articles (for fruit, tea etc.), matches, sports goods etc. Indian forests also supply minor forest products- like canes, gums, resins, dyes, tannins, lac, fibers, flocks, medicines, Kath etc.

Tribal people forests also provide food (tuber, roots, leaves, fruits, meat from birds and other animals) and Medicare.

**2) Protective functions** These functions include conservation of soil and water, prevention of drought and protection against wind, cold, radiation, noise, sights and smells, etc.

**3) Regulative functions** Forests are a major factor of environmental concern, providing protection to wildlife, help in balancing the gaseous ($CO_2$, $O_2$) cycles of atmosphere, tend to increase local rainfall and water holding capacity of soil, maintain the soil fertility, regulate the earth's temperature, water cycles, check soil erosion, land slides, shifting of sand and silting and reduce flood havoc.

**Over- exploitation**

Human beings have depend 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. shooted up resulting 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.

## 3.12 DEFORESTATION (FOREST DESTRUCTION)

Total forest area of the world in 1900 was nearly 7000 M.ha. By 1975 it was reduced to 2890 M.ha. By 2005 it was reduced to 2370 M.ha. and if continues like this by 2015 it would be merely 2000 M.ha.

Destruction of biotic potential of land leads to desertification. Such problem arises due to over grazing, indiscriminate felling of trees and over exploitation of land resources.

The disadvantaging effects of deforestation in India include soil, water and wind erosions, estimated to cost over 16,400 crores every year.

Deforestation has a major impact on the productivity of our croplands. This happens in two ways-

1. Soil erosion increases manifold and the soil actually gets washed, leading to an accentuated cycle of floods and drought.

2. But equally important is the impact of the shortage of firewood on the productivity of our croplands.

**Causes of deforestation**

- Forests destroyed for growing demand of the cities.

- Local cattle, goats, sheep etc. destroy the vegetation.

- Shivalik sal forests were over exploited for industrial use (railway sleepers etc.)

- Demand of fuel wood and timber due to increase population.

- Construction of roads, railways, houses, dams and power stations.

- The faulty planning of Govt. and its negligence towards forests.

- The green house effect.

**Effects of deforestation**

Deforestation affects human life in several ways. The main effects of deforestation are as follows

1. Forests, particularly on mountains, provide considerable protection from floods by trapping and absorbing precipitation (i.e rain, snow etc) and slowly releasing it later. When the forest is removes, the amount of runoff water flowing into rivers and streams increases several fold causing frequent floods.

2. Deforestation results in increased soil erosion and decreased soil fertility. In drier areas, deforestation can lead to the formation of deserts. on an average India is losing about 6,000 million tons of top soil annually due to water erosion in the absence of trees.

3. Deforestation causes the extinction of forests dwelling plant, animal and microbial species resulting into a loss if irreplaceable genetic resources.

4. Deforestation also threats indigenous (tribal) people whose culture and physical survival depend upon the forests.

5. Deforestation induces regional and global climate change. The climate has become warmer due to lack of humidity in the deforested regions.

6. The pattern of rainfall has changed in deforested areas. The rainfall has declined and droughts have

become common.

7. Deforestation also contributes to global warming stored carbon into the atmosphere as CO2, which is a greenhouse gas.

8. Human beings are deprived of benefits of forest trees and wild animals.

**Timber and Wood**

Total world wood consumption is about 360 million tons i.e. about 360 million m3/ year, more than steel and plastics together, weight- wise commercial timber and round wood (unprocessed logs) are used to make lumbers, plywood, veneer, particle board and chip board. Approximately 15 crore people depend only on fuel wood for their energy. Average quantity of wood requirement in the world is 1 m3/year/person for cooking and heating.

*China suffered a lot from erosion and floods as it has cut millions of trees 1000 years ago. However, 4.5 million hectares/ year were planted between 1983 – 1993.

**Effects of timber extraction**

There has been unlimited exploitation of timber for commercial use. Commercial/industrial demand could out-strip supply leading to decimation of forests, particularly the wood.

The major effects of timber extraction on forests and tribal people include

* poor logging results in a degraded forests.

* soil erosion, especially on slopes.

* sedimentation of irrigation systems.

* floods may be intensified by cutting of trees on upstream watersheds.

* loss of biodiversity.

* climatic changes, such as lower precipitation.

* new logging roads permit shifting cultivators and fuel wood gatherers to gain access to logged areas and fell the remaining trees.

* loss of non-timber products and loss of long-term forest productivity on the site affect the subsistence economy of the forest dwellers.

* forest fragmentation, the reduction of a large block of forest to many smaller tracts, promotes loss of biodiversity because some species of plants and animals require large continuous areas of similar habitat to survive.

* species of plants and animals, which may occupy marrow ecological niches and whose potential value to humans is unknown, may be eliminated.

* indigenous people may be forced into a new way of life for which they are unprepared.

* exploitation of tribal people by the contractors.

* cutting of more trees than permitted in a particular area by the greedy contractors.

# CHAPTER 4

# ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES

## 4.1 ENVIRONMENTAL POLLUTION

Environmental pollution refers to the presence or introduction of harmful substances or contaminants into the natural environment that cause negative effects on living organisms and their surroundings. This can include pollutants in the air, water, soil, and other aspects of the environment.

There are many types of environmental pollution, including:

1. Air pollution: This is the presence of harmful substances in the air, such as chemicals, particulate matter, and gases like carbon monoxide and sulfur dioxide.

2. Water pollution: This is the presence of harmful substances in bodies of water, such as lakes, rivers, and oceans, which can harm aquatic life and also contaminate sources of drinking water.

3. Soil pollution: This is the presence of harmful substances in the soil, such as pesticides and heavy metals, which can reduce soil fertility and harm plants and animals that rely on the soil for their habitat.

4. Noise pollution: This is excessive or unpleasant sound that can cause stress, hearing damage, and other negative health effects in humans and animals.

5. Light pollution: This is the excessive use of artificial lighting, which can interfere with natural rhythms and behaviors of animals and disrupt ecosystems.

6. Thermal pollution: This is the release of excess heat into bodies of water or the atmosphere, which can have negative effects on ecosystems and wildlife.

Environmental pollution has many negative impacts on the environment, including harm to plant and animal life, damage to ecosystems, and negative health effects in humans. It is important to take action to

prevent and mitigate environmental pollution through measures such as reducing emissions, improving waste management, and using cleaner technologies.

**History of pollution**

Pollution has been a problem throughout human history, although it has taken different forms in different times and places. Here are some examples of pollution throughout history:

- Ancient civilizations: The ancient civilizations of Greece, Rome, and Egypt had problems with pollution. In ancient Rome, for example, the pollution was so bad that laws were passed to try to control it. One law required that tanners and dyers had to set up their businesses at least 200 feet away from the nearest residential area.

- Industrial Revolution: The Industrial Revolution, which began in the late 18th century, brought about a huge increase in pollution. The burning of coal to power factories and transport led to high levels of air pollution, and rivers and streams became heavily polluted with industrial waste.

- 20th century: In the 20th century, pollution became a major issue in many parts of the world. In the United States, the Cuyahoga River caught fire several times due to the high levels of pollution in the water. This helped spur the passage of the Clean Water Act in 1972. The problem of air pollution also became more apparent, and laws such as the Clean Air Act were passed to try to control it.

- Present day: Pollution remains a major problem today, with concerns about climate change, air pollution, water pollution, and plastic pollution. Efforts are being made to reduce pollution and protect the environment, but there is still much work to be done.

Pollution: Any atmospheric condition, in which certain substances are present in such concentration that they can produce undesirable effects on man and his environment.

**Pollutant:** Any substance which causes pollution called as pollutant.

**Classification of Pollutants**: It is done from different point of view.

(I) Depending upon their existence in nature pollutants are of two types, namely quantitative and qualitative pollutant.

a) Quantitative pollutants: these are those substances normally occurring in the environment, who acquire the status of a pollutant when their concentration gets increased due to the unmindful activities of man. For example, carbon dioxide, if present in the atmosphere in concentration greater than normal due to automobiles and industries, causes measurable effects on humans, animals, plants or property, and then it is classified as quantitative pollutant.

b) Qualitative pollutant: these are those substances which do not normally occur in nature but are added by man. e.g. Insecticides.

(II) Depending upon the form in which they persist after being released into the environment, the pollutants are categorized into two types, namely primary and secondary pollutants.

a) Primary Pollutants: these are those which are emitted directly from the source and persist in the form in which are added to the environment. E.g. Ash, smoke, dust, fumes, SO2, HC etc.

b) Secondary Pollutants: These are those which are formed from the primary pollutants by chemical interaction with some constituent present in the atmosphere. E.g.SO3, NO2, O3, aldehyde.

(III) From the ecosystem point of view, i.e., according to their natural disposal, pollutants are two types:

a) Bio-degradable Pollutants: these are the pollutants that are quickly degraded by natural means. E.g. heat or thermal pollution, and domestic sewage etc.

b) Non-degradable Pollutants: these are the substances that either do not degrade or degrade very slowly in the natural environment. E.g. Hg salt, DDT, Aluminum cans etc.

## 4.2 TYPES OF POLLUTANTS

1. Bio degradable pollutants - decompose rapidly by natural processes.

2. Non- degradable pollutants - do not decompose or slowly decompose in the environment.

**Classification of Pollution**

ü Air pollution

ü Water pollution

ü Soil pollution

ü Marine pollution

ü Noise pollution

ü Thermal pollution and

ü Nuclear hazards

### 4.2.1 Air Pollution

***"Air Pollution is the release of pollutants such as gases, particles, biological molecules, etc. into the air that is harmful to human health and the environment."***

Air Pollution Diagram


**FIG 4.1 AIR POLLUTION**

Air pollution refers to any physical, chemical or biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affects plants, animals and humans drastically.

There is a certain percentage of gases present in the atmosphere. An increase or decrease in the composition of these gases is harmful to survival. This imbalance in the gaseous composition has resulted in an increase in earth's temperature, which is known as global warming.

#### 4.2.1.1 Types of Air Pollutants

There are two types of air pollutants:

Primary Pollutants

The pollutants that directly cause air pollution are known as primary pollutants. Sulphur-dioxide emitted from factories is a primary pollutant.

Secondary Pollutants

The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants. Smog, formed by the intermingling of smoke and fog, is a secondary pollutant.

Sources and effects of air pollutants:

**1. Particulate Pollutants:**

Particulate refers to all atmospheric substances that are not gases but they may be suspended droplets or solid particles or mixtures of the two. Their size ranges from 100 μm to 0.1 μm and less. Larger particles like sand and water droplets quickly settle down in still air and smaller particle s like dust remain in air for longer time whereas very fine particles like tobacco smoke do not settle down at all.

Particulates classifies as-

Dust: Size 1 to 200 micrometers. These are formed by natural disintegration of rock and soil or by the

mechanical process of grinding and spraying. They have large setting velocities and are removed from the

air by gravity and other inertial process.

Smoke: Size 0.001 to 1 micrometer. This can be liquid or solid and are form by combustion or other chemical

process.

Fumes: Size 0.1 to 1 micrometer. There are solid particles which are normally released from chemical or

metallurgical processes in industries.

Mist: Size < 10 micrometer. It is made up of liquid droplets. These are formed by condensation in the

atmospheric or released from industrial operations.

Effects: Respiratory problems- Bronchitis, asthma, irritation etc.

**2. Gaseous Pollutants**

1. Oxides of sulfur:

Sources: Chemical industries, metal smelting, pulp and paper mills, oil refineries.

SO2 is a colorless gas with a characteristic, sharp, pungent odor. It is moderately soluble in water forming weak acid H2SO3. It is oxidized slowly in clean air to SO3 In polluted atmosphere SO2 reacts photo chemically or catalytically with other pollutants or normal atmospheric constituents to form SO3, H2SO4 and salts of H2SO4.

Effects:

- SO2 and moisture can accelerate the corrosion of steel, copper, zinc and other metals.

- H2SO4 mist in the atmosphere causes deterioration of structural monuments or materials such as marble and lime stone.

- Clothes, leather and Paper discolored by SO2.

- 8 – 12 ppm of SO2 - immediate throat infection, 10 ppm SO2 – eye irritation, 20 ppm – immediate coughing.

- High concentration of SO2 suffers plats from chlorosis (disappearance of chlorophyll), metabolic inhibition, plasmolysis and even death.

2. Nitrogen Dioxide:

Sources are natural and manmade.

Naturally nitrogen dioxide coming from high energy radiation, biological and non-biological activities

(lightening, radiations, bacterial decomposition etc).

Man-made nitrogen dioxide coming from incineration process, pesticide industries, automobiles etc.

Effects:

- NO2 combine with hydrocarbons to form photochemical smog its cause most damage to human health.

- In lungs NO2 converted to nitrous and nitric acids which are highly irritating and cause damage to the lung tissues.

- It causes acid rain and cancer.

3. Carbon monoxide:

Sources: Incomplete combustion of carbon fuels in automobiles, industries etc.

The main sources of CO in the urban air are smoke and exhaust fumes of many devices burning of coal, gas or oil.

Effects: CO reacts with blood hemoglobin to form carboxyhemoglobin.

1-5% COHb in blood –reduction in oxygen carrying capacity of blood.

30-40% COHb in blood- Severe headache, vomiting.

50-60% COHb in blood- Coma.

70-80% COHb in blood – Fatal coma (death).

4. Hydrocarbons:

Sources: are automobiles, natural fire, industrial source (refineries), spray paintings, inks ,etc.

Effects: Skin, nose, throat, eye irritation. Cause cancer in human beings.

#### 4.2.1.2 Causes of Air Pollution

Following are the important causes of air pollution:

Burning of Fossil Fuels

The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

Automobiles

The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.

Agricultural Activities

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilisers emit harmful chemicals in the atmosphere and contaminate it.

Factories and Industries

Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.

Mining Activities

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air, but also deteriorate the health of the workers and people living in the nearby areas.

Domestic Sources

The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.

Effects of Air Pollution

The hazardous effects of air pollution on the environment include:

Diseases

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.

Global Warming

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged underwater.

Acid Rain

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life.

Ozone Layer Depletion

The release of chlorofluorocarbons, halons, and hydrochlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

**Effect on Animals**

The air pollutants suspend in the water bodies and affect aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animal species.

### 4.2.1.3 Air Pollution Control

Following are the measures one should adopt, to control air pollution:

i) Reducing air pollutants from industry:

Industry in its broadest sense is a major contributor to air pollution. However, the management of these sources of pollution has not always been undertaken in the most efficient manner. The following two points should be considered in management strategy.

a) A holistic view of pollutant emissions must be taken. Thus strategies to reduce air pollution must not lead, for example, to greater water pollution.

b) The whole process operation must be examined. Pollutants may actually represent losses of valuable material (e.g. solvents), and measures to prevent their loss may actually save money.

ii) Changing the nature of the fuel:

Where pollutant emissions are due to the type of fuel being used for combustion modifying the fuel can have significant effects on emissions.

iii) Changing process conditions to reduce pollutant production:

Some pollutants are produced during the process itself. Examples include the production of nitrogen oxides during combustion, or dioxins

during incineration. Alterations to the way hat processes are operated can significantly reduce the creation of these pollutants.

iv) Cleaning the flue gases: If it is not possible to prevent the production of pollutants, then it is likely to be necessary to prevent their release into the environment by cleaning the exhaust gases.

v) Reducing ammonia emissions from agriculture:

The most important source of ammonia emissions from agriculture is that from livestock waste. The ammonia may be emitted at any stage, from the production of the waste through to its final storage and use on the load.

a) Reducing nitrogen intake by animals: Careful assessment of the protein requirements of livestock is an important means of reducing the amount of nitrogen excreted. By matching live weight food requirements to nitrogen input, it is generally possible to reduce nitrogen intake by about 5 %.

b) Animal housing: Intensive animal housing can producing important point sources of ammonia emissions. A build-up animal waste in moist conditions is ideal for pollution production.

For poultry units, droppings should be dried rapidly. Deep litter systems alone do not really reduce emissions. However, a reduction of up to one-third can be achieved

c) Animal waste storage: It is generally not possible to use animal waste as it is produced. The waste is produced continually through out the year, spreading is limited, for example, to periods between cropping. Storage of waste is therefore required to minimize the ammonia emissions.

vi) Managing pollution from motor vehicles: The problem of traffic pollution is a particularly difficult issue. Traffic volume is increasing rapidly in almost every country in the world, and strategies to manage the resulting pollution are desperately needed.

There are a number of types of management that can be adopted: 1. Changing the type of fuel.

2. Removing inefficient and grossly polluting vehicles.

3. Adopting measures to clean the exhaust gases.

4. Attempting to manage the pollution once it has been produced.

5. Adopting measures to manage the use of motor vehicles.

Some of these measures are best adopted at national or international levels, others are open to local management.

1. Managing fuel type: The best example of this has been the adoption of unleaded petrol.

2. Removing gross polluters: by stopping old vehicles.

3. Cleaning exhaust gases: By fitting a simple particulate trap in the exhaust.

Traffic management: by vehicle speed and vehicle use.

And other general methods for control of air pollution:

1.Source correction methods: use of quality raw materials, process changes, equipment modification or replacement etc.

2.Industrial estates should be established at a distance from residential areas.

3.Use of tall chimneys shall reduce pollution surroundings.

4.Poisonous gases reduced by passing the fumes through wet towers scrubbers or spray collectors.

5.Compulsory use of filters and electrostatic precipitators in chimneys.

6. Afforestation.

7.Complete electrification of railway lines.

8.Use of pollution free fuels for vehicles. Ex. Alcohol, hydrogen, battery power etc.

9.Use non lead antiknock agent in gasoline.

**Avoid Using Vehicles**

People should avoid using vehicles for shorter distances. Rather, they should prefer public modes of transport to travel from one place to another. This not only prevents pollution, but also conserves energy.

**Energy Conservation**

A large number of fossil fuels are burnt to generate electricity. Therefore, do not forget to switch off the electrical appliances when not in use. Thus, you can save the environment at the individual level. Use of energy-efficient devices such as CFLs also controls pollution to a greater level.

**Use of Clean Energy Resources**

The use of solar, wind and geothermal energies reduce air pollution at a larger level. Various countries, including India, have implemented the use of these resources as a step towards a cleaner environment.

**Other air pollution control measures include:**

By minimising and reducing the use of fire and fire products.

Since industrial emissions are one of the major causes of air pollution, the pollutants can be controlled or treated at the source itself to reduce its effects. For example, if the reactions of a certain raw material yield a pollutant, then the raw materials can be substituted with other less polluting materials.

Fuel substitution is another way of controlling air pollution. In many parts of India, petrol and diesel are being replaced by CNG – Compressed Natural Gas fueled vehicles. These are mostly adopted by vehicles that aren't fully operating with ideal emission engines.

Although there are many practices in India, which focus on repairing the quality of air, most of them are either forgotten or not being enforced properly. There are still a lot of vehicles on roads which haven't been tested for vehicle emissions.

Another way of controlling air pollution caused by industries is to modify and maintain existing pieces of equipment so that the emission of pollutants is minimised.

Sometimes controlling pollutants at the source is not possible. In that case, we can have process control equipment to control the pollution.

A very effective way of controlling air pollution is by diluting the air pollutants.

The last and the best way of reducing the ill effects of air pollution is tree plantation. Plants and trees reduce a large number of pollutants in the air. Ideally, planting trees in areas of high pollution levels will be extremely effective.

**NATIONAL AMBIENT AIR QUALITY STANDARDS**

| **S. No** | **Pollutants** | **Time Weighted Average** | **Concentration in Ambient Air** | | | **Measurement Method** |
|---|---|---|---|---|---|---|
| | | | **Sensitive Area** µg/m³ | **Industrial Area** µg/m³ | **Residential Area** µg/m³ | |
| 1 | Sulphur Dioxide (SO2) | Annual<br>24 hours | 15<br>30 | 80<br>120 | 60<br>80 | West &Greek method<br>UV Fluorescence |
| 2 | Oxide of Nitrogen (N2O) | Annual<br>24 hours | 15<br>30 | 80<br>120 | 60<br>80 | Jacob & Ochheiser Metho<br>GasPhase chemilumloesence |
| 3 | Suspended | Annual | 70 | 360 | 140 | High volume Sampling |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Particulate Matter (SPM) | 24 hours | 100 | 500 | 200 | (avg. flow rate not less than 1.1m³/min) |
| 4 | Respirable particulate mater | Annual<br>24 hours | 50<br>75 | 120<br>150 | 60<br>100 | Respirable Particulate Matter Sampler |
| 5 | Lead | Annual<br>24 hours | 0.50<br>0.75 | 1.0<br>1.5 | 0.75<br>1.00 | ASS Method after sampling using EPM 2000 |
| 6 | Carbon Monoxide | 8 Hours<br>1 Hours | 1.0<br>2.0 | 5.0<br>10.0 | 2.0<br>4.0 | Non Dispersive IR |

### 4.2.2 WATER POLLUTION

Water pollution is defined as any physical, chemical or biological change in quality of water that has a harmful effect on living organisms or make unsuitable for needs.

#### 4.2.2.1 Cause of water pollution:

There are two major cause/sources of water pollution, namely point and non-point sources.

A: Point sources: those sources which can be identified at a single location are known as point sources. Identification, monitoring and control makes easy. For instance, the flow of water pollutants through regular channels like sewage systems, industrial effluents, power plant out lets etc.

B: Non-point sources: those sources whose location cannot be easily identified are called non-point or diffused sources. Identification, monitoring and control are not easy. For instance, agriculture (pesticide, fertilizers), mining, construction, acid deposition from atmosphere etc.

#### 4.2.2.2 MAJOR POLLUTANTS:

1. Oxygen Demanding Waste:

Source: Sewage effluent, agricultural runoff, industrial effluent (paper, pulp processing unit)

Effects: decomposition by anaerobic bacteria depletes level of dissolved oxygen in water. Flora and fauna persistent. Further decomposition by anaerobic bacteria produces foul smell.

2. Plants Nutrients:

Source: Sewage effluent, phosphate from detergents, agricultural runoff, nitrates and phosphates from fertilizers.

Effects: Algal bloom (eutrophication), aquatic life is effected, organic matter increases.

3. Acids:

Source: Acid rains, mine drainage, excessive planting of coniferous forest makes soil acidic.

Effects: Acidification of natural waters, species diversity affected, aquatic life diminishes, toxic metal level increases, lower crop yields, accelerates corrosion, unusable for drinking or irrigation.

4. Toxic metals Hg, Pd, Cd, Zn, Sn.

Source: Mining and its associated industries, vehicles, batteries discharge etc.

Effect: Bio magnification of toxic metal with successive stage of food chain, threat to consumers.

5. Oil:

Sources: Drilling operation, oil tanker spills, natural seepage, waste disposal.

Effect: contamination of aquatic environment leading to death of birds, fishes and mammals.

6. Sediments

Source: land erosion

Effect: cloud water and photosynthesis reduces disrupt aquatic food webs, carry pesticides, bacteria and other harmful substances, clog and fill lakes, reservoirs, stream channels etc.

7. Radiation

Source: natural source, nuclear weapons testing's, X-rays, nuclear energy, industries

Effect: Degree of tissue damage risk of death depends on exposure persistent in environment.

8. Heat

Source: coolant water from industry, power plants

Effect: species diversity changes, aquatic life effected, killed by suffocation, disruption of reproductive cycle of fish and aquatic organisms.

Drinking water quality standards refers to a reference point for standard setting and drinking water safety. Drinking water is the potable water meant for human consumption for drinking and cooking purposes from any source. It should be of the highest purity to meet the needs of the community.

Based on international standards for drinking water quality issued by WHO in India Bureau of Indian Standard specification IS: 10500-1991 governed the quality of drinking water supplies in India.

### 4.2.3 SOIL POLLUTION

In modern economics, various types of activity, including agriculture, industry and transportation, produce a large amount of wastes and new types of pollutants.

### 4.2.3.1 Sources and effects of soil pollution:

1. Chemical pollutants: The chemical pollutants such as calcium carbonate, bicarbonates, calcium sulphate, and soluble salts etc. from eroded sediments pollute the soil. It is estimated that 85% of phosphorus and about 70% of nitrogen loading of surface water are brought from eroded soil from hills or other places. The tanneries, synthetic drug factories and distilleries discharge lot of suspended and dissolved solids which pollute the soil. The presence of all these substances also retards growth of plants, retards reproduction process and also fruit production.

2. Metallic pollution: The metallic pollutants from Cu, Steel, Cd, Zn, factories pollute the soil due to excess of Cu, Fe, Cd and Zn. Besides this, the presence of Co, Ni, Pb, Ba, Mn, Al, Sr, Silicon, Ca etc, added to the soil from various industries in combined form also pollute the soil such pollution by metals is called metallic pollution.

3. Industrial effluents: Industries are major sources of soil pollution now a days. Sugar factories, textile, steel, paper, chemical and pesticide, petroleum, engineering, cement, glass, dyeing, oil refineries and other factories are responsible for addition of more than 40 million tones of substances in the soil as industrial wastes.

These toxic chemicals through soil and water enter into vegetables, fruits, grains, etc. and enter into food chain of human beings and are responsible for number of diseases and even cancer.

4. Agricultural wastes: For increasing the production in agriculture – lot of fertilizers, pesticides, herbicides etc. are added in each season with the soil is getting harder every year due to these inorganic chemicals called agricultural wastes in agricultural fields.

Soil conditioners, fumigants contain toxic metals such as Cd, Hg, Co, Pb, etc. increase of their concentration in soil they enter into crops and finally to food chain of human being causing mental, skin, lung, blood and urine diseases.

Today 30% diseases in human beings are suffered due to presence of fungicides, insecticides, herbicides etc, Fertilizers add phosphorus, nitrogen, sodium, potassium, sulphate, nitrate etc. in the soil. The high concentration of nitrates and phosphates also cause eutrophication, choking the whole aquatic ecosystem in nature.

The animal waste have been found to contain high BOD (>300 ppm) and high COD (>500 ppm) and nitrogem (>450 ppm) and hence such wastes are very very harmful for human beings.

The villages in India, villagers use cow dung for burning purposes but it is dangerous for health as it generates benzo-pyrene in smoke which causes cancer to human beings.

5. Urban wastes: The urban wastes contain substances like glass bottles, glass plates, plastics, paper, rubber, fibres, iron pieces, garden leaves, branches, flowers, parts of vehicles, food residues, vegetable residues, fuel residues, dust, metallic pieces, cane etc. polythene bags and other household articles.

6. Radio active pollutants: The radio nuclides such as Iodine -129, Caesium -137, Barium -140, Strantium

– 90, Promothium- 144, Ruthenium- 106 which are produced from nuclear fission get deposited on the soil which continuously emit gamma radiation which are harmful for plants, aquatic life and human beings.

7. Biological agents: The biological agents cause pollution of soils and crops. Bacteria, algae, nematodes, actinomycetes, rotifers, protozoans etc. are important biological agents which change the physical texture of the soil and are responsible for changing the fertility of the soil. The human and animals excreta are the major source of land pollution.

8. Pesticides: Pesticides like DDT, BHC, malathion, endrin, aldrin, parathion etc. cause impairment of human tissues, failure in the functioning of liver, kidney, intensive and gonads.

9. Detergents: Detergents pollute the soil and river water. They destroy the fertility of the soil and retard the growth of plants and fruits.

#### 4.2.3.2 Control of soil pollution:

1. The garbage can be converted into compost manure by cobalt and nickel techniques recently developed.

2. Half of the total dung collected in villages is used as fuel. This must be stopped at once as this fuel on burning releases benzo-pyrene which cause cancer. If this bio-manure is used in fields the crop production will be increased.

3. Solid wastes should be treated by pyrolysis method. Fluided bed furnaces and multiple hearth furnaces can also be used to yield better results.

4. Salts flow to soil from industries must be stopped.

5. Environment protection Act, 1986 be implemented with full force to factories and municipal corporations to check the flow of untreated wastes directly into the soils.

6. The land act should be implemented strictly against the industries which pollute the soil.

7. A huge plantation is necessary along the roads, fields, waste places, marshes, and nearby railway linings. Among these plants planted on the boundary of the fields to avoid soil erosion and to increase the fertility of the soil.

8. The industrial effluents should be first treated and then allowed to discharge through constructed drains.

9. The use of pesticides should be avoided as it will destroy the fertility of the soil in time to come.

10. The organic manure be used in the fields in place of chemical fertilizers as later will also destroy gradually the fertility of the soil.

11. The garbage first be treated and then it should be converted into manure as is happening in western countries. It should never be used in fields as it will destroy the fertility of the soil permanently.

12. Environmental awareness programmes be arranged to create awareness among students and others to check the pollution of soil.

13. Toxic and non-degradable materials must be totally banned.

14. Recycling and reuse of industrial and domestic wastes can minimize soil pollution considerably.

### 4.2.3.3 Effects of Modern Agriculture:

Effects of agriculture on the environment can be broadly classified into three groups, viz, regional and global:

a. Local changes: These occur at or near the site of forming. These changes/ effects include soil erosion and increase in sedimentation downstream in local rivers. Fertilizers carried by sediments can cause eutrophication of local water bodies. Polluted sediments can also transport toxins and destroy local fisheries.

b. Regional changes: They generally result from the combined effects of farming practices in the same large region. Regional effects include deforestation, desertification, large scale pollution, increases 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. In tropical waters, sediments entering the ocean can destroy coral reefs that are near the shore.

c. Global changes: These include climatic changes as well as potentially extensive changes in chemical cycles.

For more yield modernized inputs like high yielding varieties, fertilizer use, intensive irrigation and pesticide applications. These modernized techniques of cultivation can cause serious ecological stresses. These impacts can be in the forms of reduced soil fertility, increased soil salinity, water logging, chemical pollution of surface and ground water by fertilizers, imbalances in the ecosystems etc.

**Problems of fertilizer applications:**

1. Increased salinity in the soil resulting osmotic pressure this cause increase the water demand of the crop.

2. Surplus waters from agricultural fields carry the fertilizer into natural water bodies and ground water. Surface and ground water polluted by fertilizers.

3. Fertilizer application promoting the crop yield will deplete the micro nutrients in the soil, it progressively infertile.

4. Soil micro flora loses.

Problems of pesticides and herbicides applications:

1. Along with the pests (insects, worms, rodents), non-target organisms which have a useful and essential organisms are killing by pesticides and herbicides.

2. Some pest becomes resistant to the poison in due course.

DDT (Dichlorodiphenyl tetra chloro ethane), Endrin, BHC (Benzene hexa chlorine) etc, pesticides are applied in the form dry dusts, wet table powders, solutions. These cause air pollution.

3. Bio- Amplification: If an animal received small quantities of persistent pesticides or other persistent pollutants in its food and is unable to eliminate them the concentration within the animal increases. This process of accumulating higher amounts of material within the cell of an animal is called 'bio-accumulation'.

When an affected animal is eaten by a carnivore, these toxins are further concentrated in the body of the carnivore, causing disease or death, even though lower-trophic-level or grains are not injured. This phenomenon of acquiring increasing levels of a substance in the bodies of higher-trophic-level organisms is known as 'biological amplification'.

Ex. Phytoplankton Zooplankton 1 unit 100 units

Small fish 1000 units

Big fish 10,000 units Bird1 lakh

#### 4.2.3.4 Soil Salinity:

Accumulation of excessive salts in the soil system makes it unfit for cultivation. Accumulation of excessive salts in soil is known as 'Salt efflorescence'.

**Causes:**- Water logging is the main cause of salt efflorescence. Continuous evaporation from water logged areas leaving the dissolved salts behind, causes accumulation of excessive salts.

- Excessive application of chemical fertilizers can increase the soil salt content.

- Percolation of domestic and industrial sewage adds up to the soil salts. Effects of soil salinity:

1. When the salinity increases the tolerance limit of a crop, the land is unfit for the crop.

2. Decreasing of plant yield.

3. Percolation of rain water the ground water turns saline by the lechates of the soil with excessive salts.

4. Soil bacterial systems are upset. Soil bacteria play a vital role in the equilibrium of an ecosystem in nature.

1. Water logged should be avoided.

2. Excessive application of chemical fertilizers should be avoided.

3. Waste water discharges should be controlled qualitatively and quantitatively.

**Water Logging:**

Water logging is the phenomenon of ground water table rising too close to the ground level to sustain useful plant life.

Causes of water logging:

1. Over irrigation of land

2. Seepage losses from canals

3. Surface spreading of waste waters

4. Excessive rainfall

5. Poor land drainage.

6. Poor permeability of the soil system etc. Effects of water logging:

1. The land cannot sustain useful plant life.

2. Evaporation from water logged areas leaving salts behind, builds up the soil salinity to a level that inhibits vegetation.

3. Mosquitoes and other vectors and worms proliferate.

4. Organic matter in the soil under goes an anaerobic decomposition due to water logging, creating bad odors and ground water pollution.

5. Water supply systems and waste water disposal systems face additional difficulties in design and operation.

6. Structural foundations are difficult to construct.

1. Excessive watering of crops due to farmer's ignorance should be avoided.

2. Irrigation canal should be lined.

3. Evapotranspiration should be increase with suitable plantations. Avesenia plants are suitable for water logged areas.

#### 4.2.3.4 Soil / Land Degradation:

Soil/Land degradation refers to deterioration or loss of fertility or productive capacity of the soil. Land resources are very much related to natural disasters like volcanic eruptions, earthquakes etc. but it is due to human activities that soil gets polluted. Land degraded by soil erosion, salination, water-logging, desertification, shifting cultivation, urbanization, landslides and soil pollution.

**A. Soil erosion**: The top layer of the soil contains nutrient required by the plants. This fertile top soil is most valuable natural resource, at a depth of 15 – 20 cm. The loss of top soil or disturbance of the soil structure is known as 'soil erosion'.

**Types of soil erosion:**

a. Based on the rate of soil loss takes place, there are two main types:

1. Normal or geologic erosion: It occurs under normal, natural conditions by it-self without any interference of man. As natural, it is very slow process, unless there is some major disturbance by a foreign agent.

2. Accelerated soil erosion: This type of removal of soil is very rapid and never keeps place with the soil formation. This is the serious type of loss, generally caused by an interference of an agency like man and other animals.

b. Agents of soil erosion:Based on the various 'agents' that bring about soil erosion and the 'form' in which the soil is lost during erosion, there are following types-

a. Water erosion: caused by the action of water, which removes the soil by falling on as 'rain drops', as well as by its 'surface flow' action.

b. Soil erosion: Soil loss by wind is common in dry (arid) regions, where soil is chiefly sandy and the vegetation is very poor or even absent. High velocity winds blow away the soil particles.

c. Landslides or Slip erosion: The hydraulic pressure caused by heavy rains increases the weight of the rocks at cliffs which come under gravitational force and finally slip or fall off. Sometimes entire hillock may slide down.

d. Stream bank erosion: The River during floods splashes their water against the banks and thus cuts through them.

e. Deforestation & Over grazing: Effects of deforestation and over grazing are well known on soil loss. In India annual loss of soil nutrients

in this way is of the order of 5.37 million tons of N, P, K valued at about Rs.700 crores.

B. Salination:Salinationrefers to increase in the concentration of soluble salts in the soil. Poor drainage of irrigation and flood waters results in accumulation of dissolved salts on the soil surface. In arid and semi-arid areas with poor drainage and high temperatures, water evaporates quickly leaving behind a white crust of salts on the soil surface. The high concentration of salts in soil severely affects the water absorption process of the plants, resulting into poor productivity.

C. Water logging: Water logging may be due to surface flooding or due to high water table. Excessive use of canal irrigation may disturb the water balance and create water logging as a result of seepage or rise in the water table of the area. The productivity of water logged soil is severely affected reduce due to lesser availability of oxygen for the respiration of plants.

D. Desertification: Desertification is a slow process of land degradation that leads to desert formation. I is like a 'skin disease' over planet wherein patches of degraded land, eruption separately, gradually join together. For example, Thar Desert (India) was formed by the degradation of thousands of hectares of productive land. It may result either due to a natural phenomenon linked to climatic change or due to abusive use of land.Mismanagement of natural resources including land, certain irreversible changes has triggered the breakdown of nutrient cycles and micro climatic equilibrium in the soil indicating the ones of desert conditions.

E. Shifting Cultivation: Shifting (Jhum) cultivation, a very peculiar practice of slash and burn agriculture, prevalent among many tribal communities inhabiting the tropical and sub- tropical regions of Africa, Asia and Islands of Pacific Ocean has also laid large forest tracts bare. This practice has led to complete destruction of forests in many hilly areas of India, North-East and Orissa, and caused soil erosion and other associated problems of land degradation.

F. Urbanization: Human activities are responsible for the land degradation of forests, croplands and grass lands. The productive areas

are fast reducing because of urbanization i.e., the developmental activities such as human settlements and industries.

G. Landslides: Human activities such as construction of road and railway, canal, dams and reservoir and mining in hilly areas have affected the stability of hill slopes and damaged the protective vegetation cover above and below roads and other such developmental works. This has upset the balance of nature, making such areas vulnerable to landslides.

H. Soil Pollution: Industrial effluents contain high concentration of chemicals. For example Paper and Pulp industrial waste water contain organic matter, Soap industrial waste water contain fatty acids,

fertilizer industrial waste water contain chemicals etc. these chemicals degrade the soil fertility and loss of microorganisms.

Control of Land Degradation

The process of soil formation is slow that soil can be considered as non-renewable resource. Therefore, control of land degradation is very important and can be achieved by taking the following measures:

a) Afforestation and reforestation

a. Afforestation means growing forests where there were no forests before, may be due to lack of seed trees or adverse factors.

b. Reforestation means replanting forests at places where they were destroyed by overgrazing, excessive felling, forest fires etc. restoring forests helps to check soil erosion, floods and water logging.

b) Better Agricultural Practices

a. Terracing: a large sloping drainage area is divided into a number of small distinctly separate flat fields called terraces. These slow down the speed of run-off water; hold the water longer on the land so that more of it is soaked into the land and this result in higher crop yields.

b. Regular Cultivation: field should not be left bare and there should be regular cultivation of the fields with a vegetation cover so that erosion

is checked and maximum water in filters into the soil due to minimum run-off of water.

c. Crop Rotation: this involves sowing of different crops in the same field in a regular sequence for a number of years.

d. Fallowing: aeration, texture and fertility of soil can be improved by ploughing the fields extensively and then leaving them without sowing for a year or two.

c) Planting Wind Breaks and Shelter Belts

To check the velocity of wind, two or more rows of tall trees are planted at right angles to the direction of the prevailing winds. These wind breaks check the movements of wind and therefore check soil erosion.

### 4.2.4 NOISE POLLUTION

Question 10: What is noise pollution? Write its sources, effects and control.

Solution: “Unwanted sound dumped into the atmosphere leading to health hazards.” Or “Wrong sound in the wrong place at the wrong time.” Or

“The unwanted, unpleasant or disagreeable sound that causes discomfort for an living beings.”

The sound intensity is measured in decibel (dB). Sounds at 0-10 dB are so quit that they are almost impossible to hear, while at the top end of the scale, at around 150dB it can damage the eardrums. Some common sound with decibel rating are 0dB total silence, 13dB human heart beat, , library place 30dB, heavy street traffic 60-80dB, boiler factories 120dB, jet planes (take off)- 150dB, rocket engines 180dB.

#### 4.2.4.1 Sources of noise

Main contributors to noise are industries, transportation (air, rail and road) and community and religious activities.

1. Industrial sources:

Progress in technology (industrialization) has resulted in creating noise pollution. E.g. Textile mills, printing presses, engineering establishments and metal works etc.

2. Transport Vehicles:

Automobile revolution in urban centers has proved to be a big source of noise pollution.

E.g. heavy trucks, buses, trains, jet-planes, motor cycles, scooters, etc.

3. Domestic noise:

It is any noise from residential areas such as house, apartment and flat. The noise coming from neighbors and the most common problems are banging of doors, noise of playing children, crying of infants, moving of furniture, loud conversation, record player, TVs, mixer-grinders, pressure cookers, A.C, vacuum cleaner, barking of dogs, car alarms etc.

4. Incompatible land use:

Generally the determination of land use zoning includes the separation of activities which are incompatible due to noise levels.

E.g. heavy industrial area will be separated from residential areas by light industrial, recreational facilities and retail activities.

5. Construction noise:

Construction noise is defined as 'the noise created by the equipment's at the construction sites for the fabrication, erection, modification, demolition or removal of any structure of facility, including all related activities such as land clearing, site preparation, excavation, landscaping'. It is a major source of noise pollution which is emitted by construction equipment's. e.g. rollers, tractors, trucks, concrete mixers, cranes, pumps, generators, hammers, drillers, saws, vibrators, cutters etc.

### 4.2.4.2 Effects of Noise Pollution:

Noise is generally harmful and serious health hazard. It has far reaching consequences and has many physical, physiological as well as psychological effects on human beings.

1. Physical Effects:

It is the effect on earing ability. Repeated exposure to noise may result in temporary or permanent shifting of hearing threshold of a person depending upon the level and duration of exposure.

"Deafness" caused due to continuous noise exposure. Temporary deafness occurs at 40 – 60 dB noise. Permanent loss of hearing occurs at 100dB. Bombay and Calcutta are the noisiest cities in the world.

2. Physiological Effects:

a. Headache by dilating blood vessels of the brain.

b. Increase in the rate of heart beat.

c. Narrowing of arteries.

d. Fluctuations in the arterial blood pressure by increasing the level of cholesterol in the blood.

e. Decrease in heart output.

f. Pain in the heart.

g. Digestive spasms through anxiety and dilation of the pupil of eye, thereby causing eye-stain.

h. Impairment of night vision.

i. Decrease in the rate of color perception.

j. Lowering of concentration and affect on memory.

k. Muscular stain and nervous breakdown.

3. Psychological Effects:

a. Depression and fatigue which reduces the efficiency of a person.

b. Insomnia as a result of lack of undisturbed and refreshing sleep.

c. Straining of senses and annoyance (irritation).

d. Affecting of psychomotor performance of a person by a sudden loud sound.

e. Emotional disturbance.

4. Communication Interference:

Noise masks speech as a result greater pains for the talker as well as the listener.

#### 4.2.4.3 Control of Noise Pollution:

1. Control at Receiver's End:

For people working in noisy installation, ear-protection aids like ear-plugs, ear-muffs, noise helmets, headphones etc. must be provided to reduce occupational exposure.

2. Suppression of noise at source:

a. Designing, fabricating and using quieter machines to replace the noisy ones.

b. Proper lubrication: This can be done by- designing and fabricating silencing devices in air crafts engines, automobiles, industrial machinery and home appliances. And by segregating the noisy machines.

c. Installing noisy machines in sound proof chambers.

d. Covering noise producing machine parts with sound absorbing materials to check noise production.

e. Reducing the noise produced from a vibrating machine by vibration damping.

f. Using silencers to control noise from automobiles, ducts, exhausts etc. And convey systems with ends opening into the atmosphere.

g. Using glass wool or mineral wool covered with a sheet of perforated metal for the purpose of mechanical protection.

3. Acoustic zoning:

Increased distance between source and receiver by zoning of noisy industrial area, bus terminals, and railway stations aerodromes etc. away from the residential areas would go a long way in minimizing noise pollution.

4. Planting of trees:

Planting green trees and shrubs along roads, hospitals, educational institutions etc. helps in noise reduction to a considerable extent.

5. Legislative measures:

Strict legislative measures need to be enforced to curb the menace of noise pollution like

a. Minimum use of loudspeakers and amplifiers especially near silence zones.

b. Banning pressure horns in automobiles.

c. Framing a separate noise pollution act.

## 4.3 SOLID WASTE

The wastes generated and discarded from human and animal activities that are normally solid are called as solid wastes. The term 'refuse' is often interchangeably with the term solid wastes.

Types of solid wastes

Depending upon the nature, solid wastes is broadly classified into three types,

1. Municipal wastes.

2. Industrial wastes

3. Hazardous wastes.

Mounds of garbage are a common sight today. Waste thrown is omnipresent in the form of rotting piles that dot our landscape, foul our rivers and pollute our wells and lakes. Even the idea of a quaint, clean village is no longer true because trash has overcome the rural-urban divide very successfully. What this waste, why is more & more of it being produced and exhibited, and how have we become adept at this? Most importantly, can we as individuals and as a society reduce this growing menace?

Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas. It may be categorised in three ways. According to its:

- origin (domestic, industrial, commercial, construction or institutional)
- contents (organic material, glass, metal, plastic paper etc)
- hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc).

Solid Waste Management reduces or eliminates the adverse impact on the environment & human health. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal. The quantum of waste generated varies mainly due to different lifestyles, which is directly proportional to socio economic status of the urban population.

**Numbers!**

In metro cities in India, an individual produces an average of 0.8 kg/ waste/ person daily. The total muicipal solid waste (MSW) generated in urban India has been estimated at 68.8 million tons per year (TPY) (0.573 million metric tonnes per day (MMT/d) in the year 2008). The average collection efficiency of MSW ranges from 22% to 60%.

MSW typically contains 51% organic waste, 17% recyclables, 11% hazardous and 21% inert waste. However, about 40% of all MSW is not collected at all and hence lies littered in the city/town and finds its way

to nearby drains and water bodies, causing choking as well as pollution of surface water. Unsegregated waste collection and transportation leads to dumping in the open, which generates leachate and gaseous emissions besides causing nuisance in the surrounding environment. Leachate contaminates the groundwater as well as surface water in the vicinity and gaseous emissions contribute to global warming.

**Types of Solid Waste**

It can be classified into different types depending on their source:

- Municipal Solid Waste (MSW): It consists of household waste, construction and demolition debris (CnD), sanitation residue, and waste from streets, generated mainly from residential and commercial complexes. As per the MoEF it includes commercial and residential waste generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes;

- Industrial Solid Waste (ISW): In a majority of cases it is termed as hazardous waste as they may contain toxic substances, are corrosive, highly inflammable, or react when exposed to certain things e.g. gases.

- Biomedical waste or hospital waste: It is usually infectious waste that may include waste like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc., usually in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. These can be a serious threat to human health if not managed in a scientific and discriminate manner.

## 4.4 SOLID WASTE MANAGEMENT

Centralised method: This method involves collection of municipal waste from all over the local area and by means of landfilling, dump outside the city/nagar panchayat limits. This process looks at door-to-door collection of solid waste by waste pickers who hand over to the collection team who then discard the collected waste in the landfill. The waste pickers are employees of the Municipal Corporation or Nagar Panchayat. The collection team is generally contracted out by a tendering process.

1. De-centralized method: This is a model seen in a few places like Suryapet in Andhra Pradesh and Bangalore in Karnataka. The waste is collected ward-wise and is segregated at source into bio-degradable and non-biodegradable. The biodegradable waste is composted at a nearby facility by different methods of aerobic and anerobic composting. The non-biodegradable waste is further categorised into paper, plastic, metal and other waste and then further collected by recyclers for up-cycling or downcycling of products

**Treatment methods for solid waste**

- 

- Thermal treatment: Incineration is the combustion of waste in the presence of oxygen, so that the waste is converted into carbon dioxide, water vapour and ash. Also labeled Waste to Energy (WtE) method, it is a means of recovering energy from the waste. It's advantages include waste volume reduction, cutback on transportation costs and reduction of greenhouse gas emissions. However, when garbage is burned, pollutants, such as mercury, lead, dioxins may be released into the atmosphere, and cause health issues.

- Pyrolysis and gasification: In this method, thermal processing is in complete absence of oxygen or with less amount of air.

- Biological treatment methods: This involves using micro-organisms to decompose the biodegradable components of waste. The 2 types of processes: Aerobic: This needs the presence of oxygen and includes windrow composting, aerated static pile composting & in-vessel

composting, vermi-culture etc. Anaerobic digestion: Takes place in the absence of oxygen.

- Landfills and open dumping: Sanitary landfills: It is the controlled disposal of waste on land in such a way that contact between waste and the environment is significantly reduced and the waste is concentrated in a well defined area. Dumps are open areas where waste is dumped exposing it to natural elements, stray animals and birds. With the absence of any kind of monitoring and no leachate collection system, this leads to the contamination of both land and water resources.

Integrated Solid Waste Management (ISWM):

**Recycling**

Recycling is when waste is converted into something useful. It reduces the amount of waste that needs to be treated, the cost of its handling, its disposal to landfills and environmental impacts. It also reduces the amount of energy required to produce new products and thus helps conserve natural resources. Upcycling and downcycling are two common words used when it comes to recycling. Upcycling implies upgrading of a commodity by different processes of recycling. An example of upcycling is to make roads out of cheap plastic. Downcycling implies downgrading a commodity by different processes of recycling. An example of downcycling is breaking down of high quality plastics at high temperature into different lower quality plastics.

There are a large set of informal waste collectors in India. They are called local waste dealers or 'Kabadiwallahs'. They collect and sort dry waste into aluminium, plastic, paper, glass, etc. Each waste has a price fixed in the waste market. In some cases, these local waste dealers have tie ups with waste pickers who supply to them the waste from nearby areas. In addition to the waste pickers, the dealers also collect dry waste from individuals, apartments and institutions.

**Responsibility & stakeholders**

Solid Waste Management is a state subject and it is the responsibility of the state government to ensure that appropriate solid waste management practices are introduced in all the cities and towns in the state. However,

SWM is a municipal function and it is the urban local bodies (ULB) that are directly responsible for it. The ULBs are required to plan, design, operate, and maintain the SWM in their respective cities/towns. India's 4378 municipalities spend a lot of money handling waste. Between 10% to 50% of the municipal budget is allocated for SWM and between 30% to 50% of the total staff are typically engaged in SWM. This critical service, if performed poorly, results in deterioration of health, sanitation and environmental degradation. Incorrect choice of technology, lack of public participation, financial constraints, institutional weakness, are factors that prevent a ULB from providing satisfactory service. The ULBs need both support and guide to mange the solid waste in a scintific and cost effective manner.

The role of the Government is broadly to formulate policy guidelines and provide technical assistance to the states/cities whenever needed. It also assists the state governments and local bodies in human resource development and acts as an intermediary in mobilizing external assistance for implementation of solid waste management projects.

There are several NGOs, waste trade unions and experts who have become crucial stakeholders. A few well recognised people and organisations are: Chintan in Delhi, Swacha in Pune, Stree Mukti Sangathan in Mumbai, Solid Waste Management Round Table and Hasiru Dala in Bangalore.

**Rules and regulations associated with SWM**
Under the 74th Constitutional Amendment, Disposal and managemenf of Municipal Solid Waste is one of the 18 functional domains of the Municipal Corporations and Nagar Panchayats. The various rules and regulations for solid waste management are:

1. The Bio-Medical Waste (Management And Handling) Rules, 1998
2. Municipal Solid Waste (Management And Handling) Rules 2000
3. The Plastic Waste (Management And Handling) Rules, 2011
4. E-Waste (Management And Handling) Rules, 2011

There are other court cases that find their importance in terms of Solid Waste Management in India:

1. Almitra Patel vs. Union of India
2. B.L Wadhera vs. Union of India.
3. Judgement of Karnataka High Court towards Mandatory Segregation at Source

**Ragpickers/ manual scavenging**

Waste Management also has several informal players such as ragpickers. They work in dump sites, garbage spots in local areas and trade in their collected waste with local dealers. These local dealers are called Kabadiwalahs.The large network of informal sector also aids in managing of waste effectively at local levels as the Kabadiwallahs are connected to the formal group of recyclers who come and pick up the bulk quantity of waste. There is a National Body of Ragpickers in India. They are called the NSWAI- National Solid Waste Association of India. Formed on 25th January 1996, the association is also a member of the International Solid Waste Association (ISWA), and provides a forum for the exchange of information and expertise in the field of Solid Waste Management at the international level.
In recent times, Prohibition of Employment as Manual Scavengers and their Rehabilitation Bill, 2013 has been passed in the Lok Sabha in September 2013.

**How each one of us can reduce waste**
Waste is everybody's responsibility. A waste reduction strategy can be incorporated by each of us whether at home or at work by following the **4 Rs principle.** This will not only reduce the amount of solid waste going to landfill, but turn waste into a resource & also save our fast depleting natural resources.

**Reduce:** At home you can begin by purchasing things with lesser packaging, more durable & refillable items, carry your own shopping bag, avoid disposable items and reduce the use of plastics. At office one can cut down on paperwork, use electronic mail for communication.**Reuse:** You can donate your old clothes, books, phones and lots more. You can reuse old bottles, jars as storage bins and buy rechargeable items rather than disposable ones.

**Recycle:** Segregate your waste for better disposal and purchase recycled/ green products. A ton of paper from recycled material conserves about 7,000 gallons of water, 17-31 trees, 60 lb of air pollutants and 4,000 KWh of electricity. You can recycle or compost your organic waste directly at source- leaving very little waste to reach the landfill. Watch this video of Vani Murthy, who composts in her own apartment.

**Recovery or reclaim:** Various mechanical, biological and caloric systems and technologies can convert, reprocess or break up waste into new materials or energy. This means turning waste into fuel for manufacturing processes or equipment designed to produce energy. For example, the methane caused by rotting materials in dump sites can be recycled. Of course, this "R" is difficult for individuals to apply and applies more for industries or towns with a high volume of waste to manage.

## 4.5 COMPOSITION AND CHARACTERSTIC OF e-WASTE AND ITS MANAGEMENT

E-waste, popularly referred to electronic waste of electronic goods (including discarded computers, TVs sets, VCRs, stereos, copiers, fax machines, electronic lamps, cell phones, audio equipment, batteries, pagers, scanners, refrigerators, washing machines, microwaves ovens, DVDs, floppies, tapes, printing cartridges, military electronic waste, chips, processors, motherboard and other electronic devices) which have become outdated due to advancement in technology, modifications in the life-style, fashion or nearing the end of their useful life.

The amount of e-waste generated in our country is rapidly increasing due to the generation of our own waste as well as dumping of e-waste from the developed countries.

### COMPONENTS OF E_WASTE:

Some of the components of e-waste include lead, cadmium, mercury, hexavalent chromium, PVC, barium, toxic dioxins and furans (Polybrominated dibenzodioxins, polychlorinated dibenzo furans)

**HEALTH EFFECTS:**

Damage to central and peripheral nervous systems, damage to brain, heart, kidney, liver, skin, respiratory disorders, reproductive and developmental problems, damages to immune system, disruption of endocrine system functions.

**MANAGEMENT OF E-WASTE:**

1: Waste Minimization Techniques: it involves following aspects,

i) Inventory Management: a reduction in the quantity of waste generation can achieved by proper control of the materials used in the manufacturing process by reducing the amount of hazardous material and raw material used in the process. The inventory management procedure should ensure that all materials be approved before purchase. The material should be evaluated for hazardous constituents and opt for alternative non-hazardous materials if available. As needed basis materials should be purchased.

ii) Alternation in the Production Process: Modifications in the production process can minimize the waste generation. This includes changing the materials used to make the product and efficient use of input material. A proper training program must be given to the employees, including correct operation and handling procedures, proper equipment use, precise specifications about maintenance and inspection schedules and management of waste materials.

iii) Reduction in Hazardous Portion of Waste: Reduction in the volume of hazardous waste can be accomplished by source segregation and waste concentration. Both these methods are economical techniques for waste reduction. The techniques used in volume reduction are gravity, vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.

iv) Recovery and Reuse of E-Waste: e-waste is recovered on-site or at an off-site facility by various techniques including reverse osmosis, electrolysis, condensation, filtration, centrifugation etc.

2: Designing Sustainable Products: Efforts should be made to reduce material use and propose a centralized network system. Bio-based

products such as tonners, glues and inks must be used. Moreover, the product designers should ensure reusable, repairable and upgradeable materials that are safer.

## 4.6 POLLUTION CONTROL TECHNOLOGIES

### 4.6.1 Control of water pollution:

Various ways or techniques for control of water pollution are as follows:

1. Stabilization of ecosystem: This is the most scientific way to control water pollution. The basic principles involved are the reduction in waste input (thus control at source), harvesting and removal of biomass, trapping of nutrients, fish management and aeration.

2. Farmers can reduce the running of fertilizers from their agricultural lands to the nearby water bodies and leaching into aquifers. This can be obtained by using slow release fertilizers in sloped ground. Also this can be achieved by providing buffer zones between the surface water body and the agricultural land.

3. Over fertilization and improper application of pesticides can be avoided.

4. By using more biological control pests, the pesticide usage may be minimized.

5. Acid/alkali/organic/toxic substances in industrial or municipal wastes should be treated properly.

6. Soil erosion can be minimized by reforesting critical and important water sheds.

7. By improving manure control and planting buffer zones, the runoff and infiltration of manure from animal feedlots may be controlled.

8. Reutilization and recycling of waste: Urban waste (sewage) may be recycled to generate cheaper fuel gas and electricity. One distillery in Gujarat is able to treat 450000 liters of waste daily and generating energy equal to that produced by 10 tons of coal.

9. Removal of pollutants: Various pollutants (radioactive, chemical, biological) present in water body can be removed by appropriate methods such as adsorption, electrolysis, ion-exchange, reverse osmosis etc.

Ex: Ammonia removed by ion-exchange process, Mercury- selective ion exchange resin, phenolics- polymeric adsorbents, discoloration of water- electrolytic decomposition, sodium salts- reverse osmosis.

10. Setting up effluent treatment plants to treat waste.

11. Industrial wastes must be treated before discharge.

12. Educate public for preventing water pollution and the consequences of water pollution.

13. Strict enforcement of water pollution control act.

14. Continuous monitoring of water pollution at different places.

15. Developing economical method of water treatment.

16. River, streams, lakes and other water reservoirs must be well protected from being polluted.

### 4.6.2 WASTE WATER TREATMENT METHODS

The main objectives of waste water treatment are,

1. To convert harmful compounds into harmless compounds.

2. To eliminate the offensive smell.

3. To remove the solid content of the sewage.

4. To destroy the disease producing microorganisms.

### A) EFFLUENT TREATMENT PLANTS(ETP):

Raw sewage consists of residential, commercial and industrial liquid water discharges. Such waste waters are processed in waste water treatment plants to produce and effluent of higher quality and then discharged back to the environment.

The effluents may be treated by one of the following processes.

1. Physical treatment.

2. Chemical treatment.

3. Biological treatment.

A. Physical Treatment: The suspended solids in effluents may be separated by centrifugation, filtration, decantation, filter press, rotary vacuum filter, belt press, micro strainers, slow sand filters, up flow sand filters, rapid gravity sand filters, surface skimmers, grit chambers, misers, aerators and diffusers.

In some cases, screens are used for removal of large suspended matter. Comminutor are used for reduce the particle size of suspended solid matter. Constant velocity channels are used in effluent treatment plants to remove grit from suspended matter to prevent damage to sewage treatment plants. Sedimentation tanks are large tanks used to remove fine suspended matter. The sewage is passed into sedimentation tanks where the sludge settles to the bottom of the tank. The floating materials like oil and grease are skimmed off while the sludge settled at the bottom of the tank is continuously removed.

B. Chemical Treatment: Chemical treatment includes coagulation and flocculation processes. The chemical coagulants used in the chemical process are ferrous or ferric sulphate, aluminum sulphate, calcium hydroxide and polyelectrolytes. Addition of a suitable chemical coagulant to the effluent results in the formation of a precipitate or flock that settles to form sludge.

Further treatment of effluent is accomplished by flocculation process which is mediated by addition of polyelectrolytes of the effluents. This is followed by passing the effluents through sinuous flocculation channels, hydrodynamic flocculators of mechanically mixed flocculators.

C. Biological Treatment: The biological treatment of effluents is achieved by either of the ways,

i) Aerobic process ii) Anaerobic process.

## B) SEWAGE TREATMENT PLANTS(STP):

Sewage is contaminated water discharged from domestic, industrial, municipal and other sources. Sewage treatment plant is designed to remove the contaminants from the water so that they can be recycled and reused. Both organic and inorganic contaminants are removed by using different physical, chemical and biological processes. The treatment plant produces waste stream which is a treated effluent and a solid waste or sludge which are reused.

Sewage is collected and transported via a network of pipes and pump stations to a municipal treatment plant. Normally three stages are involved for treating sewage- primary, secondary and tertiary. After being treated the effluent can be reused to flush toilets, greening parks, or for recharging ground water.

Objective: - The Principal objective of waste water treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment.

Conventional wastewater treatment processes

Conventional wastewater treatment consists of a combination of Physical, chemical, and biological processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater.

A. Preliminary treatment

The objective of preliminary treatment is the removal of coarse solids and other large materials often found in raw wastewater. Removal of these materials is necessary to enhance the operation and maintenance of subsequent treatment units. Preliminary treatment operations typically include coarse screening, grit removal and, in some cases, communication of large objects.

B. Primary treatment

The objective of primary treatment is the removal of settle able organic and inorganic solids by sedimentation, and the removal of materials that will float (scum) by skimming.

C. Secondary treatment

The objective of secondary treatment is the further treatment of the effluent from primary treatment to remove the residual organics and suspended solids. In most cases, secondary treatment follows primary treatment and involves the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment processes. Aerobic biological treatment is performed in the presence of oxygen by aerobic microorganisms (principally bacteria) that metabolize the organic matter in the waste water, thereby producing more microorganisms and inorganic end-products (principally CO2, NH3, and H2O). Several aerobic biological processes are used for secondary treatment differing primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter. Common high-rate processes include the activated sludge processes, trickling filters or bio filters, oxidation ditches, and rotating biological contractors (RBC). A combination of two of these processes in series (e.g. bio filter followed by activated sludge) is sometimes used to treat municipal wastewater containing a high concentration of organic material from industrial sources.

D. Tertiary Treatment

Wastewater is given tertiary treatment to further enhance its quality before they are discharged in the environment. After the secondary treatment removes most of the organic matter present in sewage lowers BOD (25ppm). The popular methods that are used in this stage are filtration, flocculating, removal of chemicals like nitrogen and phosphorus etc.

Different sewage treatment processes are required to remove nitrogen and phosphorus. Nitrogen is removed through the biological oxidation of nitrogen from ammonia to nitrate, followed by denitrification, the reduction of nitrate to nitrogen gas which is removed to the atmosphere. Phosphorus on the other hand can be removed by using two process that is by the use of specific bacteria, called polyphosphate that accumulate large quantities of phosphorus within their cells they are removed from the water and are used as fertilizer. Chemical precipitation can also be used to remove phosphorus. Municipal Wastewater is sometimes further disinfected by using chlorine, ozone gas and ultraviolet light.

**C) COMMON AND COMBINED EFFLUENT TREATMENT PLANTS(CETP):**

Common Effluent Treatment Plants is the concept of treating effluents by means of collective effort mainly for a cluster of small scale industrial units. This concept is similar to the concept of Municipal Corporation treating sewage of all the individual houses. The main objective of CETP is to reduce the treatment cost for individual units while protecting the environment.

- To achieve 'Economics of scale' in waste treatment, thereby reducing the cost of pollution abatement for individual factory.

- To minimize the problem of lack of technical assistance and trained personnel as fewer plants require fewer people.

- To solve the problem of lack of space as the centralized facility can be planned in advance to ensure that adequate space is available.

- To reduce the problems of monitoring for the pollution control boards.

- To organize the disposal of treated wastes and sludge and to improve the recycling and reuse possibilities.

### 4.6.3 Control of Air Pollution

The following methods are most effective for dealing with the control of air pollution.

(a) Source Correction Methods. (b) Pollution Control Equipment.

© Diffusion of Pollutant in air. (d) Vegetation.

(e) Zoning.

A. Source Correction Methods:

Industries make a major contribution towards causing air pollution. Formation of pollutants can be prevented and their emission can be minimized at the source itself. By carefully investigating the early stages

of design and development in industrial processes e.g., those methods which have minimum air pollution potential can be selected to accomplish air pollution control at source itself.

**These source correction methods are:-**

I. Substitution of raw materials:

Raw material causing air pollution should be substituted by another purer grade raw material which reduces the formation of pollutants. e.g. coal with LPG or LNG.

II. Process Modification:

The existing process may be changed by using modified techniques to control emission at the source.

e.g. fly ash emissions are reduced by washing coal before pulverization and by adjusting air intake of boiler furnace.

III. Modification of Existing Equipment:

By suitable modifications in the existing equipment air pollution can be minimized.

a. Open hearth furnaces are replaced with controlled basic oxygen furnaces or an electric furnace reduces smoke, CO and fumes.

b. In petroleum refineries if storage tanks are designed with floating roof covers reduces loss of hydrocarbon vapors.

IV. Maintenance of Equipment:

Poor maintenance of equipment (leakage around ducts, pipes and pumps etc.) pollution is caused which can be minimized by routine checkup of seals and gaskets.

B. Pollution Control Equipment:

Sometimes pollution control at the source is not possible by preventing the emission of pollutants. Then it becomes necessary to install pollution

control equipment to remove the gaseous pollutants from the main gas stream.

Pollution control equipment's are generally classified into two types:

a. Control devices for particulate contaminants.

1. Gravitational Settling Chamber:

2. Cyclone Separators ( Reverse Flow Cyclone):

3. Fabric Filters:

4. Electrostatic Precipitators:

5. Wet Collectors ( Scrubbers):

b. Control devices for gaseous contaminants.

1. Wet absorption methods.

2. Dry absorption methods.

A. Control devices for particulate contaminants.

a. Gravitational Settling Chamber:

For removal of particles exceeding 50μm in size from polluted gas streams, gravitational setting chambers are put to use.

This device consists of huge rectangular chambers. The gas streams polluted with particulates is allowed to enter from one end. The horizontal velocity of the gas stream is kept low in order to give sufficient time for the particles to settle by gravity. The several horizontal shelves or trays improve the collection efficiency by shortening the settling path of the particles.

b. Cyclone Separators ( Reverse Flow Cyclone):

Centrifugal force is several times greater than gravitational force it is generated by spinning gas stream and this quality makes cyclone

separators more effective in removing much smaller particulates than gravitational settling chambers.

It consists of cylinder with a conical base, a tangential inlet discharging near the top and outlet for discharging the particulates is present at the base of the cone.

c. Fabric Filters:

In this a stream of the polluted gas is made to pass through a fabric that filters out the particulate pollutant and allows the clear gas to pass through. The particulate matter is left in the form of a thin dust mat on the insides of the bag. This dust mat acts as a filtering medium for further removal of particulates increasing the efficiency of the filter bag to sieve more sub-micron particles (0.5μm).

A typical filter is a tabular bag which is closed at the upper end and has a hopper attached at the lower end to collect the particles when they are dislodged from the fabric.

Many such bags are hung in a bag house. For efficient filtration and a longer life the filter bags must be cleaned occasionally by mechanically shakers to prevent too many particulate layers from building up on the inside surface of the bag.

d. Electrostatic Precipitators:

It works on the principal of electrostatic precipitation i.e., electrically charged particulates present in the polluted gas are separated from the gas stream under the influence of the electrical field.

In this equipment, two electrodes are used to separate the dust particles from stream. The gas stream is allowed to pass between the two electrode wires. The electrical charge is imparted to the particles through a high voltage direct current corona. The high voltage field ionizes the gas molecules in the air stream and makes the particulate matters with negative charge. The negatively charged particles are attracted by the positively charged electrodes which are called as collectors. The charge of the particles is neutralized at the moment of collection, and they can be removed from the collectors by rapping, washing or plain gravity.

e. Wet Collectors ( Scrubbers):

In this the particulate contaminants are removed from the polluted gas stream by incorporating the particulates into liquid droplets. Common types of scrubbers are:

i. Spray Tower ii. Venturi Scrubberiii. Cyclone scrubber.

Each type of scrubber has unique applicability, among the above types of scrubbers spray tower is the simplest type. They are low energy scrubbers and that can be used to remove particles of size 5 to 10 μm. venture scrubbers are of high energy scrubbers and they can be effective in removal of particles of size smaller than 3 μm.

In the spray tower the air stream with particles is introduced at the bottom. The polluted gas flows upwards. Water is introduced at the top by means if spray nozzles. By internal impaction and interception the particulate matters are entrained by the water molecules. The water with particles is collected at the bottom and disposed.

The efficiency depends on the velocity of water, size of spray, droplet size, velocity of a gas, quality of water and gas introduce and droplet trajectories. Efficiency increases with decreasing diameter of water droplet and with increasing droplet quantity.

c. Diffusion of Pollutants in Air

Dilution of contaminants in the atmosphere is another approach to control air pollution it is accomplished through the use of tall stacks which penetrate the upper atmospheric layers and disperse the contaminants so that the ground level pollution is greatly reduced.

However, the method of dilution is a short term control measure and it is not suitable for long term control. Because, the pollutants dispersed by the tall chimneys are carried and spread around the area of disposal. This may cause harmful effects to the surrounding area.

d. Vegetation Plants contribute towards controlling air pollution by utilizing CO2 and releasing oxygen in the process of photosynthesis. This purifies the air for the respiration of animals. Gaseous pollutants are

fixed by some plants. Plenty of trees should be planted especially around those areas which are declared as high risk areas of pollution.

e. Zoning This method of controlling air pollution can be adopted at the planning stages of city. Zoning advocates setting aside of separate areas for industries so that they are far removed from the residential areas. The heavy industries should not be located too close to each other.

Concept of Bioremediation: Bioremediation is concerned with the biological restoration and rehabilitation of historically contaminated sites and with the cleanup of areas contaminated in more recent times, either accidentally or incidentally, as a result of the production, storage, transport, and use of organic and inorganic chemicals. Bioremediation offers the possibility of degrading, removing, altering, immobilizing, or otherwise detoxifying various chemicals from the environment through the action of bacteria, fungi and plants. Most of the advances in bioremediation have been realized through the assistance of the scientific areas of microbiology, biochemistry, molecular biology, analytical chemistry, chemical and environmental engineering, among others. These different fields, each with its own individual approach, have actively contributed to the development of bioremediation progress in recent years.

The term bioremediation has been introduced to describe the process of using biological agents to remove toxic waste from environment. Bioremediation is the most effective management tool to manage the polluted environment and recover contaminated soil. Bioremediation is an attractive and successful cleaning technique for polluted environment. Bioremediation has been used at a number of sites worldwide, including Europe, with varying degrees of success. Bioremediation, both in situ and ex situ have also enjoyed strong scientific growth, in part due to the increased use of natural attenuation, since most natural attenuation is due to biodegradation. Bioremediation and natural attenuation are also seen as a solution for emerging contaminant problems, e.g. endocrine disrupters, landfill stabilization, mixed waste biotreatment and biological carbon sequestration. Microbes are very helpful to remediate the contaminated environment. Number of microbes including aerobes, anaerobes and fungi are involved in bioremediation process.

## 4.7 GLOBAL ENVIRONMENTAL PROBLEMS AND GLOBAL EFFORTS

### CLIMATE CHANGE

Climate represents sum of all statistical weather information of the atmospheric elements, with specified area over a long period of time. Climate never remains static but is a dynamic process, greater of lesser degree, it is changing. Climatic change is common deviation from the average as well as extreme conditions.

The Earth's surface and lowest part of the atmosphere have warmed up on average by about 0.60C during the last 100 years. If the climate change is at the same rate as now, global average surface temperature could be anywhere between 1.4 and 5.80C higher than in 1990 by 2100. Sea-level rise is projected to be between 9 and 88 cm by 2100.

The Framework Convention on Climate Change(1992) and Kyoto Protocol(1997) represent the first steps taken by the international community to protect the climate system from various dangerous man-made inferences. Currently, nations have agreed to reduce greenhouse gas emissions by about 5% by 2008 to 2012. In practical terms, this means using resources, particularly fossil fuel derived energy, more efficiently, reusing and recycling products where possible, and developing renewable forms of energy which are inexhaustible and do not pollute the atmosphere.

Cause of climate change

Climate change on the earth is influenced by the following factors:

1. Variations in the Earth's orbital characteristics.
2. Atmospheric CO2 variations.
3. Volcanic eruptions.
4. Variations in solar output.

Effect of Climate Change

The climate change has more effects on every parts of earth. It affects both living and non-living components of most of the ecosystems in the world. Some of the effects of climate change are:

1. Main sea level is increased on an average of around 1.8mm per year.

2. Many ecosystems of the world have to adapt to the rapid change in global temperature.

3. The rate of species extinction will be increased.

4. Human agriculture, forestry, water resources and health will be affected.

5. Climate change, through increasing surface temperatures, and changing rates of precipitation and evapo-transpiration, will influence the hydrological cycle.

6. The frequency and intensity of extreme weather events is possible and it makes unexpected flooding and drought.

7. The societies currently experiencing existing social, economical and climatic stresses will be both worst affected and least able to adapt.

**OZONE LAYER DEPLETION**

Ozone occurs naturally throughout the atmosphere, but most highly concentrated in the stratospherebetween 10–50 km above sea level, where it is known as the Ozone layer. Ozone is odourless, colourless gas is formed in the atmosphere when ultraviolet radiation (short wavelength< 240nm) from the sun strikes the stratosphere, splitting oxygen molecules into atomic oxygen. The atomic oxygen quickly combines with further oxygen molecules to form ozone.

$O_2 + h\nu \longrightarrow O + O$ ; $O + O_2 \longrightarrow O_3$

At ground level, ozone is health hazard and is a major constituent of photochemical smog. However in the stratosphere we need ozone to

absorb some of the potentially harmfully UV radiation from sun which can cause skin cancer and damage vegetation.

Although the UV radiation splits the ozone molecules, ozone can reform through the following reactions resulting in no net loss of ozone:

$O_3 + h\nu \longrightarrow O_2 + O$ ; $O + O_3 \longrightarrow$

Ozone is also destroyed by the following reaction with atomic oxygen.

$O + O_3 \longrightarrow O_2 + O_2$

$O_3$

The CFCs themselves do not destroy ozone molecules. But they are decaying the ozone molecules at the low temperatures. Small amounts of chlorine atom and chlorine monoxide are functioned as catalyst in the process of destruction of ozone.

$Cl + O_3 \longrightarrow ClO + O_2$

$ClO + O \longrightarrow Cl + O_2$

$O_3 + O \longrightarrow 2O_2$ .

The chlorine atom in above reaction is functioning as a catalyst and it is not consumed by the reaction. The chlorine atom used in the reaction remains there as chlorine even at the end of the reaction. Once the chlorine has broken up one ozone molecules, it is freed to repeat the process again and again, until its removal by any other means or reaction in the atmosphere. The CFCs released are stable and can live about 100 years.

Chemical and photochemical reactions in atmosphere, nuclear explosion, supersonic jet etc., generate nitric oxide.

$O_3 + NO \longrightarrow NO_2 + O_2$

Hydroxyl radical generated by biomass

$O_3 + OH^- \longrightarrow O_2 + HOO^-$

$HOO^- + O \longrightarrow OH^- + O_2$

Measuring Ozone Layer

Stratospheric ozone measurement unit is Dobson Unit. It is a scale for measuring the total amount of ozone occupying a column overhead of the atmosphere. Dobson Units are measured by how thick the layer of ozone would be if it were compressed into one layer at 00C and with a pressure of one atmosphere above it. Every 0.01mm thickness of the layer at 00C and one atmospheric pressure is equal to one D.U.

The average amount of ozone in the stratosphere across the globe is about 300 DU (or a thickness of only 3mm at 00C and 1 atmospheric pressure).

Ozone Depleting Substances (ODS)

Chlorofluorocarbons (CFCs)

CFCs (also known as Freon) are non-toxic, non-flammable, non-reactive with other chemicals and non-carcinogenic. These desirable safety characteristics, along with their stable thermodynamic properties, make them ideal for many applications as coolants for commercial and home refrigeration unit, propellants in aero jet, sprays, solvents (cleaners) in electronic industry, and blowing agents in fire extinguishers. E.g.

Trichlorofluoromethane-$CFCl_3$(CFC-11),Dichlorodifluromethane-$CF_2Cl_2$(CFC-12), Trichlorotrifluroethane-$C_2F_3Cl_3$(CFC113),Dichlorotetrafluroehane-$C_2F_4Cl_2$(CFC114), Chloropentafluroethane-$C_2F_5Cl$(CFC115)

A single CFC molecule can destroy up to 10,000 ozone molecules. A 1% loss of ozone results in a 2% increase in UV rays reaching the earth surface.

Effect of Ozone Layer Depletion

As the ozone layer gets deteriorated the harmful UV rays will reach the ground and cause various adverse effects.

1. Effect on Human Health

- Skin cancer.
- Reddening of skin in sun shine (sun burn).
- Reduction in body's immunity to disease.
- Eye disorders like Cataracts and blindness.

2. Effect on Aquatic Systems

- Decreases population of Phytoplankton which forms the base of Ocean food chain disrupts the ecosystem.

3. Effect on Materials

- Degradation of paints, plastics and other polymeric material will result in economic loss due to effects of UV radiation.

4. Effect on Climate

- The ozone depleting chemicals can contribute to the global warming i.e., increasing the average temperature of the earth's surface.

5. Effect on plants.

- Restricted growth and crop damage (reduction in chlorophyll content and increase in harmful mutations).

Steps to Protect the Ozone Layer

1. Avoid using fire extinguishers that contain halons, which have bromine in them replace them by CO2, water, or dry chemical extinguisher, foam packaging.

2. Avoid buying and using aerosols and sprays composed of CFC.

3. Maintain air-conditioning of car, freezer and clean with concern technician.IfA.C don't function properly, they emit CFC to atmosphere.

4. Opt to buy a refrigerator or A.C without CFC.

**DEFORESTATION**

Deforestation is the permanent destruction of indigenous forests and woodlands.The clearing of forests across the Earth has been occurring on a large scale basis for many centuries. This process, generally known as deforestation, involves the cutting down, burning, and damaging of forests. The loss of forest is more profound than merely destruction of destruction of beautiful areas. If the current rate of deforestation continues, the world's forests will vanish within the next 100 years-causing unknown effects on global climate and eliminating the majority of plants and animal species on the planets.

Causes of Deforestation

1. Population Explosion:

Forest land are cleared of tress to reclaim land for human settlements (factories, agriculture, housing, roads, railway tracks etc.) growth of population increases the demand for forest products like timber, firewood, paper, and other valuable products of industrial importance, all necessitating felling of trees.

2. Forest Fires:

Fires in the forests may be due too natural calamities (ground fires, surface fires, crown fires) or human activities (burning).

3. Grazing Animals:

Overgrazing by livestock has four reaching effects such as loss of porosity of soil, soil erosion and desertification of the previously fertile forest area.

4. Pest Attack:

Forest pests like insects etc. destroy tress by eating up the leaves, boring into shoots and by spreading diseases.

5. Natural forces:

Floods, storms, snow, lighteningetc. are the natural forces which damage forests.

6. Mining and Petroleum Exploration:

It leads to greater destruction of forest for exploration of ores.

7. The cash crop economy:

It is an integral part of Third World 'development' and a major cause of deforestation. The best land is taken to earn export income, which is very often used to pay the foreign debt.

8. Dams:

To generate hydroelectricity and for irrigation, dams are built which led to destruction of forest.

Effects of Deforestation

1. Habitat destruction of wild animals (tree-using animals are deprived of food and shelter).
2. Increased soil erosion due to reduction of vegetation cover.
3. Reduction in oxygen liberated by plants through photosynthesis.
4. Increase in pollution due to burning of wood and due to reduction in CO2fixation plants.
5. Decrease in availability of forest products.
6. Loss of cultural Biodiversity.
7. Scarcity of fuel wood.
8. Deterioration in economy(ecotourism) and quality of life of people residing near forests.
9. Lowering of water table due to more run-off and thereby increased use of the underground water increase the frequency of droughts.
10. Rise in CO2 level has resulted in increased global warming which in turn results in melting of ice caps and glaciers and consequence flooding of coastal areas.
11. Disruption of weather patterns and global climate.
12. Induces and accelerates mass movements/landslides.
13. Breaks the nutrient cycle.
14. The stress of environmental change may make some species more susceptible to effects of insects, pollution, disease and fire.

**DESERTIFICATION**

It refers to continuous degradation of land ecosystem due to poor rainfall, harsh climate and human activities, thus leading to reduction or loss of the biological or economic productivity. About 33% of the global land surface is subjected to desertification.

Causes of Desertification:

1. Increased Human Demand for Ecosystem Services:

Due to increase in population demand towards food, forage, fibre, freshwater and building materials for livestock, irrigationand sanitation increases.

2. Unsustainable use of scarce Natural Resources by local Land Users:

3. Socioeconomic and Policy Factors:

Absence of coherent national and regional policies for the management of watersheds, rangelands and irrigated agriculture contribute to desertification.

4. Extensive Cultivation of One Crop:

Over cultivation of crop and failure to employ crop rotation cause exhaustion of soil, land degradation, reduction in biomass productivity and soil erosion.

5. Use of Chemical Fertilizers and Pesticides:

Unsustainablefarming methods, overuse of chemical fertilizers and pesticides or insufficient use of fertilizer after harvesting contribute to desertification.

6. Shifting Cultivation:

It refers to the phenomenon where in pieces of land are cultivated temporarily until the soil loses fertility and then the land is abandoned, as it becomes infertile and unsuitable for crop production. The abandoned piece of land may be reclaimed back by allowing soil properties to recover by natural vegetation.

7. Industrial and Mining Activities:

The discharge of toxic effluents from industries into nearby lands, unplanned open cast mining, dumping of mine refuse affect the productivity of land which gradually turn into waste lands.

8. Overgrazing:

Overgrazing by livestock has four reaching effects such as loss of porosity of soil, soil erosion and desertification of the previously fertile forest area.

9. Logging and Illegal Felling:

Unchecked cutting of forest trees cause erosion of top soil by wind storms and dust storms.

10. Forest Fires:

Forest fires and smoke created by wildfires make it more difficult to form raindrops, thus resulting in scanty rainfall.

11. Unsustainable Water Management:

Poor and inefficient irrigation practices over extraction of ground water contribute to desertification.

Effects of desertification:

1. Destruction of topsoil.

2. Loss of land's ability to sustain crops, livestock's or human activity.

3. Increase in the price of agricultural goods.

4. Threatens live hood of vulnerable population on planet.

5. Increase in the intensity of wildfires and winds.

## 4.8 INTERNATIONAL CONVENTIONS/PROTOCOLS

### EARTH SUMMIT

The Earth Summit was the largest environmental conference held at Rio De Janeiro, Brazil for 12 days in June 1992. The conference had more than 30,000 participants including more than 100 heads of states. The objective of the Summit was to support the Brundtl and report, which warned the world to take immediate action towards sustained economic development without depleting the natural resources or harming the environment.

The aim was to respond,

1. Myriad global environmental problems.

2. Conservation of biodiversity.

3. Combat climate change.

4. Promote sustainable forest management.

In this context, the advanced nations demanded environmental sustainability while the developing countries argued that they should be given the opportunity to be at par with the developed world, both socially and economically.

The five major agreements made at the Rio Earth Summit include the following,

1. The convention on Biological Diversity.

2. The Framework Convention on Climate change.

3. Principles of Forest Management.

4. The Rio Declaration on Environment and Development.

5. Agenda 21 is involved in development of societies and economies by focussing on the conservation and preservation of our environments and natural resources.

The UN General Assembly has agreed to arrange for a 'Rio + 20' Earth Summit in 2012 in Brazil with focus on four areas,

1. Review of commitments.

2. Emerging issues. (Food crisis, oil prices, climate change, biodiversity loss etc.)

3. Green Economy for poverty eradication and sustainable development.

4. Institutional framework for sustainable development.

## KYOTO PROTOCOL

The Kyoto Protocol is an international agreement developed under UNFCCC (UN Framework Convention on Climate Change). The Protocol was adopted in Kyoto, Japan on 11th December 1997, which came into force on 16th February 2005. Its purpose is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system.

The participant countries are committed to cut emissions of greenhouse gases (GHGs) such as CO2, CH4, N2O, CFCs to extent possible. According to the protocol, the participants must cut down the emission of greenhouse gases by 5.2% lower than the mission levels of 1990 by 2012. Different countries were assigned different targets of emission levels and some nations were allowed an increase in emission levels. E.g. the USA was expected to lower its emission by 7%. India and china though agreed upon the protocol need not reduce greenhouse gases emissions as they are considered as the developing countries.

## MONTREAL PROTOCOL

The Montreal Protocol is an international environmental treaty designed to protect the ozone layer by phasing out the production and consumption of substances that deplete it, such as chlorofluorocarbons (CFCs). The agreement was signed on September 16, 1987, in Montreal, Canada, and entered into force on January 1, 1989.

The protocol is considered to be one of the most successful international environmental agreements ever made, as it has led to a significant reduction in the use of ozone-depleting substances. The agreement has been amended several times since its inception to accelerate the phase-out of these substances and to add new chemicals to the list of controlled substances.

As of 2021, 198 countries have ratified the Montreal Protocol, which is managed by the United Nations Environment Programme (UNEP). The protocol has been praised for its ability to bring together governments, industry, and scientists to address a critical environmental issue and for

its role in reducing the risks of skin cancer, cataracts, and other health problems associated with exposure to ultraviolet radiation.

## 4.9 WATER QUALITY PARAMATERS AND DRINKING WATER STANDARDS

| S.NO | PARAMETERS | UNITS | DRINKING WATER IS:10500-1991 | |
|---|---|---|---|---|
| | | | DESIRABLE | MAXIMUM |
| 1. | Colour | Unit | 5 | 25 |
| 2. | Odour | - | Unobjectionable | - |
| 3. | Taste | - | Agreeable | - |
| 4. | Turbidity | NTU | 5 | 10 |
| 5. | pH value | - | 6.5 to 8.5 | No relaxation |
| 6. | Total Hardness | mg/l | 300 | 600 |
| 7. | Iron | mg/l | 0.3 | 1.0 |
| 8. | Chlorides | mg/l | 250 | 1000 |
| 9. | Residual Free Chlorine | mg/l | 0.2 | - |
| 10. | Dissolved Solids | mg/l | 500 | 2000 |
| 11. | Calcium | mg/l | 75 | 200 |
| 12. | Copper | mg/l | 0.05 | 1.5 |
| 13. | Manganese | mg/l | 0.1 | 0.3 |
| 14. | Sulphate | mg/l | 200 | 400 |
| 15. | Nitrate | mg/l | 50 | No relaxation |
| 16. | Fluoride | mg/l | 1.0 | 1.5 |
| 17. | Phenolic compounds | mg/l | 0.001 | 0.002 |
| 18. | Mercury | mg/l | 0.001 | No relaxation |
| 19. | Cadmium | mg/l | 0.01 | No relaxation |
| 20. | Selenium | mg/l | 0.01 | No relaxation |
| 21. | Arsenic | mg/l | 0.05 | No relaxation |
| 22. | Cyanide | mg/l | 0.05 | No relaxation |
| 23. | Lead | mg/l | 0.05 | No relaxation |
| 24. | Zinc | mg/l | 5 | 15 |
| 25. | Anionic detergent | mg/l | 0.2 | 1.0 |
| 26. | Chromium | mg/l | 0.05 | No relaxation |
| 27. | Polynuclear Aromatic hydrocarbons | mg/l | - | - |
| 28. | Mineral oil | mg/l | 0.01 | 0.03 |
| 29. | Pesticides | mg/l | Absent | 0.001 |
| 30. | Radioactive material (a) Alpha emitters | Bq/l | - | 0.1 |
| | (b) Beta emitters | Pci/l | - | 0.037 |
| 31. | Alkalinity | mg/l | 200 | 600 |
| 32. | Aluminum | mg/l | 0.03 | 0.2 |
| 33. | Boron | mg/l | 1 | 5 |

# CHAPTER 5

# ENVIRONMENTAL POLICY, LEGISLATION & EIA

## 5.1 NATIONAL ENVIRONMENTAL POLICY

A National Environmental Policy (NEP) is a comprehensive plan or framework that outlines a country's approach to addressing environmental issues and concerns. It is a set of guidelines and principles that define the country's objectives and strategies for achieving sustainable development, while ensuring the protection and conservation of natural resources.

The primary aim of a National Environmental Policy is to promote environmental protection, conservation, and management, and ensure that development activities are sustainable and do not harm the environment. It also seeks to ensure that there is a balance between economic growth and environmental protection.

Some of the key components of a National Environmental Policy may include:

1. Environmental assessment and monitoring
2. Sustainable resource management
3. Pollution control and waste management
4. Climate change mitigation and adaptation
5. Biodiversity conservation and ecosystem management
6. Public awareness and education on environmental issues
7. Collaborative governance and stakeholder involvement

A National Environmental Policy is typically developed and implemented by the government of a country, with input and support from a range of stakeholders, including businesses, civil society organizations, and the general public. It is an important tool for ensuring that a country's development is sustainable, and that the environment is protected for future generations.

## 5.2 ENVIRONMENTAL LEGISLATION &POLLUTION CONTROL ACTS IN INDIA

India has enacted several environmental legislation and pollution control acts to ensure the protection of its environment and control the pollution levels. Some of the significant environmental laws and pollution control acts in India are:

1. Water (Prevention and Control of Pollution) Act, 1974 - This act aims to prevent and control water pollution in India by regulating the discharge of pollutants into water bodies and enforcing penalties for non-compliance.
2. Air (Prevention and Control of Pollution) Act, 1981 - This act aims to prevent and control air pollution in India by regulating emissions from industries, vehicles, and other sources.
3. Environment (Protection) Act, 1986 - This act provides a framework for the protection and improvement of the environment and the prevention of hazards to human beings, other living creatures, and property.
4. Hazardous Waste (Management and Handling) Rules, 1989 - These rules provide guidelines for the management and handling of hazardous wastes in India, including the generation, storage, and disposal of such waste.
5. National Green Tribunal Act, 2010 - This act established the National Green Tribunal as a specialized court to handle cases related to environmental disputes and to provide speedy justice in such cases.
6. Wildlife Protection Act, 1972 - This act provides for the protection of wild animals and plants, and it regulates hunting, poaching, and trade in wildlife species.
7. Forest Conservation Act, 1980 - This act regulates the diversion of forest land for non-forestry purposes and ensures that forests are conserved and managed in a sustainable manner.
8. These laws and acts, along with other environmental regulations, are essential in safeguarding the environment and preventing pollution in India. However, their effective implementation and enforcement remain a challenge, and there

is a need for greater public awareness and participation in environmental protection efforts.

**Regenerate response**

The Govt of India has formulated about 30 acts and rules related to the environment. The environmental legislations passed by Govt of India are enlisted below:

1. The Water ( Prevention & Control Pollution ) Act, 1974
2. The Water (Prevention & Control Pollution ) Cess Rules 1978
3. Forest ( Conservation ) Act 1980
4. The Air (Prevention & Control Pollution ) Act, 1981
5. The Air (Prevention & Control Pollution ) Rules 1982
6. The Air (Prevention & Control Pollution ) for Union Territories Rules Act 1983.
7. The Environment ( Protection ) Act, 1986
8. The Environment (Protection ) Rules 1986
9. Hazardous Wastes Rules 1989
10. Manufacture and storage of hazardous chemical Rules, 1989
11. The Public Liability Insurance Act 1991
12. The Public Liability Insurance Rules 1991
13. The National Environment Tribunal Act, 1995
14. Bio medical waste, Rules 1998
15. Re-cycled plastics manufacture and usage Rules, 1999
16. Dumping and disposal of Fly ash --- notification
17. Noise Pollution Rules 2000

18. Municipal solid wastes Rules 2000

19. Ozone depleting substances rules 2000

**1. The Environment ( Protection ) Act, 1986:**

Bhopal tragedy was occurred on the mid night of 2nd Dec 1984 at the UNION CARBIDE INDIA LTD, a pesticide plant in Bhopal. A leak of methyl isocyanate gas causing a death of 3,787 people and also injured for5,58,125 people.

The Govt of India enacted the Environment ( Protection) Act in the year 1986 under article 253 of the constitution. The purpose of the Act to provide a frame work on water, air, land and the inter-relationships with the human beings and other living micro-organisms…

The Act came into force on Nov, 19th 1986, the birth anniversary of late Prime Minister Indira Gandhi, who was a pioneer of environmental protection issues in India. Some important features of this Act are:

- The central Government put restrictions on an area in which any industry or operations shall not be carried out without any safe-guards.

- Emissions and effluents standards in respect of 61 categories of industries have been evolved and notified.

- Who ever fails (or) violate the environmental pollution Act, be punishable with imprisonment or with fine which may extend to one lakh rupees or both.upto 5 years

Those industries who require consent under the Environment Act are required to submit an environmental audit report to the concerned Environment Board on or before 30th Sep every year.

**2. The Air (Prevention & Control of Pollution ) Act, 1981:**

A team of Indians attended UN conference on “Human Environment” which was held at Stockholm (Europe) in the month of June 1972. Later the Air (Prevention & Control of Pollution ) Act was enacted in the Indian Parliament in 1981..

The objective of the Air Act is to establishment of Central and State Boards to prevent and control and reduce air pollution.

The air act has many sections in which 19, 20, 31A, 37 plays a vital role.

- Section -19 deals with the declaration of measures in case of industries to be established / already established. For

eg: Dust collector, noise recorder in addition to other relevant ones are important measures to establish a crushing unit.

- Section -20 deals the standards f o r emission of air pollutants.

- Section -31A deals with the closure of industry and disconnecting the electricity.

- Section – 37 deals with the penalties for violation of rules

The Air Act has made provisions for appeals. An appellate authority consisting of a single person or t h r e e p e r s o n s usually appointed by the H e a d of the State/the Governor to hear a p p e a l s as filed by any aggrieved party (industry).

The sources of air pollution such as industries, vehicles, thermal power plants etc are not permitted to release Pb, CO, SO2; NO2; volatile organic compounds, toxic substances beyond a prescribed level.

The limits of air pollutants ( micrograms / cum) in an area are as follows:

| area | SO | N | Pb | CO | |
|---|---|---|---|---|---|
| Industrial | 12 | 12 | 0.7 | 1.0 | |
| Domestic | 80 | 80 | 1.5 | 5.0 | |
| Hospitals, schools | 30 | 30 | 1.0 | 2.0 | |

The Act is created ‘ to take appropriate steps for the preservation of the natural resources of the Earth which ensure the high quality of air and ensures controlling the level of air pollution.

### 3. The Water ( Prevention & Control of Pollution ) Act 1974:

The Water Act 1974 was enacted in Parliament to prevent and control of water pollution and maintaining or restoring of wholesomeness of water.

This Act also to prevent the pollution of water by industrial, agricultural and , municipalities including domestic waste

water that can contaminate natural water resources.

Waste waters with high levels of pollutants that enter wetlands, rivers, wells etc cause serious health hazards.

Individuals can do several things to reduce water pollution by avoiding chemicals for household use; reducing

the use of pesticides in gardens and identifying the polluting sources .

The salient features and provisions of the Act are:

- Maintenance and restoration of quality of all types of surface and ground water.
- Establishment of State boards for pollution control.
- Prevention and control of water pollution.
- Central Government resolve disputes among the States if any arise
- To evolve methods of utilization of sewage and trade effluents in agriculture with proper treatment.

The Water ( Pollution)Cess Act 1978:

According to Water ( Pollution ) Cess Act, anyone consuming water has to pay certain amount of cess depending on:

- Whether the industry is using water for industrial purposes , spraying in mining areas or for boilers purpose to produce electricity.
- For domestic purposes.

- In processing units whereby water gets polluted and the pollutants are toxic.

However, those industries that had installed a suitable treatment plant for the treatment of industrial effluents can get a rebate of 70% on the cess payable. The major activities and provisions in the Water(pollution) cess Act can be summed up as follows:

The Water cess Act provides for setting up of National Parks, Wild life Sanctuaries etc… (Thus, as of today, there are 67 National Parks and 394 Sanctuaries in India ).

Under the Water cess Act, prohibition of hunting of the endangered species was mentioned. Protection to some endangered plants like Beddome cycas, B l u e V a n d a Orchid, L a d y Sliper Orchid, Pitcher Plant etc. is also included.

There is a provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc..

This act provides legal powers to officers and punishment to offenders.

**4. Forest ( conservation ) Act 1980**

Forest is a biotic community composed predominantly of trees, shrubs, bushes etc. whereas forest produce includes timber, charcoal, oils, resins, tree bark, seeds, fruits , flowers, grass, honey, wax etc. Increasing population is causing for decrease in biotic community ie forests and implementation of forest conservation is essential and mandatory. Forest (Conservation ) Act was enacted in the parliament in 1980.

The State Governments or other agencies (eg ITDA ) cannot violate the Forest ( Conservation ) Act unless prior

approval by the Central Government. The objectives of the Forest ( Conservation ) Act are:

- Restrictions on preservation of forests and use of forest land for other purposes.

- Forest land or any portion thereof may not be used for non-forest purposes.

- Forest land may not be assigned by way of lease to a private person or to any corporation / agency.

- Forest land may not be cleared off trees which have grown naturally in that land.

However, according to Section 32 of Forest ( Conservation ) Act, the State Governments can make avail the use of :

Removal of forest produces, conversion timber etc for proper utilization

Granting of license to the agencies / inhabitants to collect timber and forest produce for their own use.

Granting of license to persons for felled trees / timber and other forest produces for trade purposes.

The Forest ( Conservation ) Act also include:

- Prohibition of hunting, shooting, fishing, poisoning of water in forest areas.

- No clearance of forest land for cultivation or other purposes

- Protection of timber from fire.

**5. Wild life Act:**

India is the first country in the world to have made provisions for the protection and conservation of environment in its constitution. On 5th June 1972, environment was first discussed as an item of international agenda in the U.N. Conference of Human Environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day. Soon after the Stockholm Conference our country took substantive legislative steps for environmental protection. The Wildlife (Protection) Act was passed in 1972, followed by the Water (Prevention and Control of Pollution) Act 1974, the Forest (Conservation) Act, 1980, Air (Prevention

and Control of Pollution) Act, 1981 and subsequently the Environment (Protection) Act, 1986.

The provisions for environmental protection in the constitution were made within four years of Stockholm Conference, in 1976, though the 42nd amendment as follows:

Article-48-A of the constitution provides:

"The state shall endeavour to protect and improve the environment and to safeguard forest and wildlife of the country."

It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."

Thus our constitution includes environmental protection and conservation as one of our fundamental duties. Some of the important Acts passed by the Government of India are discussed here.

The passing of the Wildlife Act of 1972 constitutes an important landmark in the history of wildlife legislation in the country. This is because of the fact that the "Forest" including "Wildlife" was then a State subject falling in Entry 20 List II of Seventh Schedule, Parliament had no power to make law on the same except as provided in Articles 249,250 and 252 of the constitution. Having regard to the importance of the matter, the Act has been adopted by all the States except that of Jammu and Kashmir which has a similar law enacted for the purpose of wildlife protection. The operation of the Act is mandatory}' in the Union Territories too.

1. The Wildlife (Protection) Act of 1972 provides the basic framework to ensure the protection and management of wildlife. The Act was amended subsequently in 1982, 1986, 1991 and 1993 to accommodate provision for its effective implementation.

The rationale for passing Act as stated in its Statement of Objects and Reasons are as follows:

2. The rapid decline of India's wild animals and birds, one of the richest and most varied wildlife resources of the country has been a cause of grave concern.

3. Some wild animals and birds have already become extinct in this country and the other in danger of being so.

4. Areas which were once teeming with wildlife have become devoid of it and even in sanctuaries and National Parks the protection afforded to wildlife needs to be improved.

5. The Wild Birds and Animals Protection Act, 1935 has become completely outdated.

6. This existing laws not only have become outdated but also provide punishments, which are not commensurate with the offence and financial benefits that occur from poaching and trade in wildlife produce. Further, such laws mainly relate to control of hunting and do not emphasize the other factors which are also the prime reasons for the decline of India's wildlife namely taxidermy and trade in wildlife and products there from.

Salient features of the Act: The Wildlife Protection Act, 1972 which we read today is a product of process which started long ago in 1887 for the protection of a few wild birds and after addition of wild animals in 1912 and specified plants in 1991 it covered almost all the wildlife resources which need protection and management. A few salient features of the Act are as follows:

1. The Wildlife Act of 1972 as amended in 1982, 1986, 1991 and 1993 has 7 Chapters, 66 Sections and 6 Schedules. The Act with its various amendments provides the necessary tool to prevent damage to the wildlife.

2. The rating of the Schedules I to V is in accordance with the risk of survival of the wildlife (fauna) enlisted in them. Animals included Schedule are provided for total protection from hunting and the trade and commerce related to such animals are strictly regulated. The schedule VI has been added to include the specified plant species to be protected by the Wildlife (Protection) Amendment Act of 1991.

3. An expert committee, constituted by the Indian Board of Wildlife considers amendments to the Act, as and when necessary.

4. With the amendment of the Act in 1991, powers of the State Governments have been withdrawn almost totally. Now the State Governments are not empowered to declare any wild animal a vermin. Further by addition of provision, immunization of livestock within a radius of 5 km from a National Park or sanctuary has been made compulsory. Broadly speaking the amendment provides the follows:

1. Greater powers to enforcement authority.

2. Greater say to individuals or NGOs in matter concerning wildlife protection. The Central Government Officers as well as individuals now can file complaints in the court for offences.

3. NGOs like WWF-India and Traffic-India will make available technical and legal guidance when needed.

4. More impact on wildlife trade.

5. Setting up of a Central Zoo Authority.

6. Greater protection to wildlife through prohibiting hunting of wild animals other than vermin.

7. Provision to prohibit collection and exploitation of wild plants which are threatened with extinction.

8. Provision to extract and deal in snake venom for producing life saving drugs.

9. Provision to ban trade in Africa ivory.

10. Enhanced punishments for isolations.

11. Payment of rewards to persons helping in apprehension of offenders.

**6. Municipal Solid Waste ( Management and Handling ) rules 2000:**

Central Government notified in the sections of 3, 6 and 25 of the Environment (Protection) Act 1986 with the objective of regulating the management and handling of the Municipal Solid Wastes.

Municipal solid waste generate in residential and commercial areas. Residential wastes include garbage, unused house hold items, pieces of clothes, rotten vegetables etc while commercial establishments generate different wastes depending upon the

type of activity. For eg: shops and other establishments generate wastes containing large quantity of paper, and

cardboard packing cases .

The wastes from streets are also part of the municipal solid wastes. Street wastes are classified into 3 main categories

– natural waste, road traffic waste and behavioral waste.

Natural wastes include the dust blown from unused lands / roads.

Road traffic waste originate from transport vehicles. The motor vehicles while moving on the road deposit petrol, oil at sometimes and still their contents ( grease, lubricants ) on roads.

Behavioral wastes originate from wastes thrown by pedestrians using the streets and the wastes from adjoining houses, shops which spill out due to improper storage.

Municipal Solid Waste Management:

It is estimated that 291 class I and 345 Class II towns together generate 52000 tones of Municipal Solid Waste per

day in India. Solid wastes are generated @ 10,000 tons /day in all the 117 municipalities / corporations of Telangana and

Andhra-Pradesh. To minimize the municipal solid waste, the Municipal authority made an implementation of Management

plan as per Schedule – I.

Any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the procedure

laid down in Schedule - II.

The waste processing units and disposal facilities are to be set up by the municipal authority ontheir own or through

an operator shall meet the

specifications and standards as specified in schedule – III.

Treatment of solid wastes: Basically there are 3 types of disposal techniques practiced in Municipal solid wastes.

(i)Sanitary Land Fill

(ii)Composting

(iii)Incineration.

Dumping the solid waste at the out-skirts of the city, especially in low lying areas, or on either side of the road is very common. In case of mineral excavations, granite quarries or soil excavation for brick making, low lying areas are created. Restoration to original level with solid wastes is a good example for sanitary landfill.

(ii) Decomposition of solid waste material is known as composting and the final product is called compost. Compost

contains nutrients (NPK ) for the growth of plants. A few methods of treatment and disposal of composting system are given below:

The composting systems can be broadly grouped as aerobic and anerobic. Composting systems can be operated either manually or mechanically in open pits or in enclosed digesters in addition to natural process.

Aerobic composting is a process in which bacteria, actinomycites, fungi and other biological forms are actively involve. Aeration is a natural

process occurs on the surface areas of the composting mass, while the inner layers tend to progressively turn anaerobic.

Trench method is best suited for flat land where excavation can be carried out easily. A trench 2 mts deep with 5 mts length and 2 mts wide is cut. The excavated soil is placed on the sides of the trench and the trench is filled with solid waste refuse in layers and finally with a soil cover .

Area method is best used in areas where natural depressions exist as in quarries,valleys. The waste is put in the natural depressions and compacted a layer of soil is thrown on top. The process is repeated till the depression is filled up.

(iii) Incineration is a common sight to see small fires of burning dry leaves, paper etc on the sides of roads. However, such fires produce considerable smoke and air pollution.

Increasing population and rising standard of living styles create the solid waste and require integrated policies/rules and technologies.

**7. Biomedical Waste (Management and handling) rules, 1998:** Biomedical waste is also known as Hospital waste which is generated during the diagnosis, treatment, immunization of human beings or animals; in research activities or testing of biological aspects. It ma y also in clu d e wastes like anatomical waste, culture waste, discarded medicines and chemical wastes. It is also in the form of disposable syringes, broken glasses, bandages, body fluids, human excreta etc .

It has been roughly estimated that of the 4 kg of biomedical waste generated in a hospital at least 1 kg would be infected. Surveys carried out by various agencies show that due attention is not given to Biomedical waste management.

After the notification of the Bio-medical Waste (Handling and management ) Rules, 1998 establishments are slowly streamlining the process of waste collection, segregation, treatment, and disposal.

The biomedical handling rules will apply to hospitals, Nursing Homes, Veterinary Hospitals, animal Houses, Pathological labs and Blood Banks.

**Management of Biomedical waste:**

Producers who are generating the bio-medical waste need to install that biomedical waste should be collected in accordance with Schedule – I.an appropriate facility in their premises to ensure

The biomedical waste need to be segregated into containers or bags at the point of generation in accordance with Schedule – II, prior to its storage, transportation, treatment and disposal.

The containers shall be labeled according to Schedule - III.

The biomedical waste which is generated by means of various activities shall be handled without any adverse effects to the human health and the environment.

8. Hazardous Waste (Management and handling ) rules, 1989: It is a waste that makes it dangerous to human health or the environment. Hazardous wastes can be liquids, solids, gases or sludges. Waste products that are either infectious or radioactive also belong to hazardous category. The other hazardous wastes include Arsenic, Barium, Chromium, Lead, Mercury, Selenium, DDT ( Dichloro Diphenyl Trichloro ethane) substances.

Toxic wastes are harmful when a toxic substance combine with ground water.

reactive wastes (Lithium-sulphur batteries; gun powder; nitroglycerine; explosives etc cause explosions,

when heated or compressed or mixed with water ) ;

Ignitable wastes (gasoline, paint thinners; alcohol; waste oils; solvents etc create fires under

certain conditions);

- corrosive wastes (Acids or Bases that are capable of corroding metal containers such as storage tanks, drums and barrels);

• Hazardous waste ( RCRA) - Subtitle C.is regulated under the Resource The hazardous waste are listed into three categories:

**Conservation and Recovery Act**

The F- list ( waste generate in non-specific units at source points ) : Wastes generate during manufacturing of substances in industries such as solvents that have been used in cleaning operations.

The K – list ( waste generate in specific units at source points ): Wastes generate from specific industries such as petroleum refinery or pesticide manufacturing units.

The P – list and the U – list ( discarded products ): Wastes include specific commercial chemical products in an unused form. Some pesticides and some pharmaceutical products become hazardous waste when discarded. Wastes included on the P-and U-lists can be found in the regulations at 40 CFR - 261.33 .

Handling Rules:

The lead acid batteries should cover with a cap. Records ar e t o b e maintained for d i s p o s a l of hazardous waste

(collection, treatment, storage and disposal operations) in Form 3. The producer shall send annual returns to the State Pollution Control Board in Form 4.

Where an accident occurs at the hazardous waste site or during transportation of hazardous wastes, the occupier or operator of a facility shall report immediately to the State Pollution Control Board about accident in Form 5.

Case study: Environmental problems caused by hazardous wastes:

A large plastic plant located near the Minamata bay used a mercury containing compound in a reaction to produce

Vinyl Chloride , a common plastic material. The left – over mercury was dumped into the Bay along with other wastes

from the plant.

Though the mercury was in its less toxic inorganic state when dumped, the micro organisms at the bottom of the

bay converted the mercury into its organic form. This organic mercury then entered into the tissues of fish which were,

in turn consumed by the people living in the area.

The contaminated fish thus caused an outbreak of poisoning, killing and affecting several people. Mercury poisoning is thus called MINAMATA DISEASE.

## 9. ENVIRONMENTAL IMPACT ASSESSMENT

Definition of Impact: An impact can be defined as any change in physical, chemical, biological, cultural or socio-

economic environmental system as a result of activities:

### CLASSIFICATION OF IMPACTS:

Environment impacts arising from any development projects fall into three categories:

(i) Direct impacts

(ii) Indirect impacts and

(iii) Cumulative impacts.

According to their nature, these three groups reveal :

Positive and negative impacts

Reversible and irreversible impacts

Light, moderate and severe impacts

Local and widespread impacts

Short – term and long – term impacts

For eg to construct a major project: Direct impacts are related to:

(a) Aesthetics in the area (understanding of beautiful things);

(b) Traffic at nearby junctions,

(c) Removal of natural vegetation;

(d) Interference with natural water ways;

(e) Additional housing or commercial shops to support employees.

Indirect impacts may occur due to delay in time for the proposed project whereas Cumulative impact occur

where individual projects when combined with other projects may cause an overall adverse cumulative effect.

Example of various types of impacts that occur in a typical Road Development project:

**Direct impacts the land area**

are caused by the removal of gravel from a pit for use of surfacing the road . In this case, in which the pit site is located has been directly affected by activities associated with the road project.

Indirect impacts are difficult to measure, however, such as the land degradation, quality of surface water, urban growth near a new road.. New roads often lead to the rapid depletion of animals due to poaching (illegal catching and animals).

A cumulative impact might be the de-vegetation and the roadside vegetation is also damaged by vehicle and foot traffic and the soil is left unprotected.

SIGNIFICANCE OF EFFECTS: Significant effects are likely to occur where valuable resources are subject to impacts of severity. EIA is

recognized by adopting the five levels of significance as described in the draft to good practice and procedures. These five levels of significances are::

Severe: Sites of national importance and unique resources ( to exist in only one place ) if lost, cannot be replaced or relocated.

Major : These effects are to be important considerations at a regional or district scale during the decision making process..

Moderate: These effects at a local scale are likely to be key decision making issues.

Minor: These effects may be raised as local issues but are unimportant in the decision making process.

Neutral: No effect, not significant.

**10. Methods of base-line data acquisition.**

An Environmental Baseline Study ( EBS ) is an investigation conducted to establish the level of contaminants in the project areas and to assess the extent of contamination. The information needed to conduct an EBS can be acquired from the available sources:

Land features include topography; climatology ( temperature, rainfall )

Geology & Hydrogeology ( Lithology of rock formations, drainage pattern, ground water table )

Air environment (study of SPM, SOx; NOx )

Noise environment

Water Environment ( pH; TDS; F; dissolved Oxygen; BOD etc..)

Soil quality Soil analysis reflect the presence of nutrients like N, P, K, Ca, Mg, Fe, Mn and Al

Flora and Fauna of the proposed area

Socio economic study include Population density; Literacy rate; Category of workers viz., cultivators, agriculture laborers, etc); Medical facilities ; Main sources of availability of water viz., rivers, canals, hand pumps, taps etc..

**PREDICTION OF IMPACTS AND IMPACT ASSESSMENT SYSTEMS (METHODOLOGIES)**

One of the main challenges in today's society is to access to have a relevant and quality environmental data.

- An impact assessment system must consist of:

- All asp ects of consequence reports (especially a bad result report) abou t existing and future emissions to air.

- Projection of pre-situation, accidental situations etc of the site area should be mapped.

- Screening to determine the effect of impacts assessment study in a proposed project require a full or partial impact

- To identify the potential impacts to assess the alternative solutions that avoid adverse impacts on biodiversity

**11. Overview on Impacts of air, water, biological and Socio-economical aspects.**

Air Degradation, type of emissions released and the extent to which they affect air

quality, creation of excess noise and the affect air quality, creation of excess noise

and the effect on man.

Water Availability, use and quality of water, effects on the aesthetics and aquaculture

potential of ecosystems, effect on the canal systems, depletion of ground water,

pollution of waters by hazardous and toxic substances, effect on temperature and

siltation capacity.

Biological -vegetation Destruction of forest cover, depletion of cultivatable lands.

Changes in biological productivity, changes in the species diversity and harvesting the

disappearance of important species.

Cultural status Employment situation, life style of people and health services.

Ecological relationship Food chain, diseases/vectors

**12. Strategies for risk assessment:**

A Strategic Risk Assessment is a systematic and continual process for assessing significant risks facing an enterprise. Conducting an initial assessment is a valuable activity for senior management and the board of directors.

Current thought leadership on corporate governance and board responsibilities is virtually unanimous that a key board responsibility is to understand an organization's strategies and associated risks and to ensure that management's risk management practices are appropriate.

How to Conduct a Strategic Risk Assessment: The Strategic Risk Assessment process we describe is designed to be tailored to an organization's specific needs and culture. To be most useful, a risk management process and the resultant reporting must reflect and support an enterprise's culture so the process can be embedded and owned by management. If the risk assessment and management processes aren't embedded and owned by management as an integral part of their business processes, then the risk management process will rapidly lose its impact and not add to or deliver on its expected role. To help you conduct Strategic Risk Assessments, we have shown key

Strategic Risk Management tools and diagnostics at their appropriate points in the process.

Here are the seven steps for conducting a Strategic Risk Assessment:1. Achieve a deep understanding of the strategy of the organization,

2. Gather views and data on strategic risks,

3. Prepare a preliminary Strategic Risk Profile,

4. Validate and finalize the Strategic Risk Profile,

5. Develop a Strategic Risk Management Action Plan,

6. Communicate the Strategic Risk Profile and Strategic Risk Management Action Plan, and

7. Implement the Strategic Risk Management Action Plan.

These steps define a basic, high-level process and allow for a significant amount of tailoring and customization in their execution to reflect the maturity and capabilities of the organization.

**13. Concepts of Environmental Management Plan (EMP):**

Environmental Management Plan(EMP) is aimed to maintain the existing environmental quality.

The main objective of EMP is to investigate specific activities which are related to adverse impacts. The impacts can be first minimized by various planning activities. Some more measures can be practiced to minimize the impacts on environment are as follows:

The debris and unutilized construction material from construction site should be removed immediately.

Vehicles employed should be checked for proper emissions.

Construction activities shall not be allowed at night times.

The mitigation measures shall include regular maintenance of machinery and provision of productive equipment to workers where needed.

**14. Concept of Sustainable Development,**

Sustainable Development means improvement of quality of life with continuous progress without exhausting natural

resources. Society of the population must require to meet the needs by managing the natural resources efficiently and maximizing the benefits from them so as not to overload the world's ecosystem.

Sustainable development implies using the natural resources in such a manner which doesn't eliminate or diminish their usefulness for future generations eg: coal, crude oil; forests . Hence, the concept of Sustainable Development could be termed development without destruction.

Measures for Sustainable Development: Following are the measures for the sustainable development:

1. PopulationControl: Population growth should be limited to the desirable level. Slow human population growth, reduce the stress on global life.

2. Biodiversity ( variety of life on earth and how the living things interact with each other) must be conserved.

3. Recycling of wastes: Recycle at least 60% of the materials which are discarded now as trash.

4. ReducedConsumption: Lifestyle should be shifted to lesser consumption of resources.

5. Efficientusageof Resources: Resources should be renewed or reused. For eg: solar energy should be encouraged.

6. Water Resource Management: Some of the consequences of poor water resource management such as

(A) River flooding; (B) Silting of reservoirs, ponds, lakes; (C) over exploitation of groundwater; (D) Water logging by

over irrigation (E) Improper drainage (F) Pollution of water bodies are to be taken up for implementation. So, Sustainable development insists optimum management of water resources locally and globally.

7. Integrated Landuseplanning: Using lands for agriculture, forestry, fodder cultivation, industrial growth, traffic etc should be planned

8. Creating Awareness: Creation of environmental awareness and spreading environmental education among the people is must for fruitful results..

## 15. Population and its explosion:

Population is the number of individual organisms of the same species in a given area.

The study of human population is called demography. Some of the topics studies under demography are the rate and trends of growth of population with time, ratio of female to males, percentages of population in each age group etc.

**Population growth:**

The growth of human population can be viewed in four major periods:

Stage 1: An early period of hunters and gatherers:

This period ranges between the first evolution of humans on this planet to the beginning of agriculture. During this period, it is estimated that the total population was probably less than a million, population density was about 1 person per 130 – 260 sq.km in the most habitable areas, and the average population growth rate is < 0.00011% per year.

Stage 2: Early, per – industrial agriculture:

This period begin some time 9,000 B.C and 6,000 B.C and lasted approximately until the 16th century A.D. The first major increase in population came during this period. Total human population of the world

was approximately 100 million by 1 A.D that further increased greatly to about 500 million by 1600 A.D. Population average growth rate is 0.03%, population density was about 1 or 2 people per sq. km or even more.

Stage 3: The age of industrial revolution:

The second and much more rapid increase in population started about 400 years ago with the industrial revolution associated with the advances in medicines and health care. The total human population of about 900 million in 1800 A.D, almost doubled in the

century and again doubled to approximately 3 billion by 1960. The main reasons of this rapid increase in population were discovery of the causes of diseases, invention of vaccines, improvement in sanitation, and advances in agriculture that led to a great increase in the production of food, shelter and clothing.

Stage 4: The modern era:

Through the rate of population growth has slowed down in developed countries, but population still countries to increase rapidly in many parts of the world, particularly developing countries. At mid 2002, the world population stood at 6.215 billions. According to projections, the global population will be approximately 8 billions by 2025 and 10 billions by 2050 A.D.

Population variation among nations:

Asia approximately 3.7 billion population, China alone, with about 1.28 billion people, Indian subcontinent has a further 1.3 billion people India – 1.05 billion, Pakisthan – 143.5 mllion, Bangladesh – 133.6 million, Nepal – 23.9 million, Srilanka – 18.9 million, Bhutan – 0.9 million, Maldives – 0.3 million. Most populous European countries are Russia – 143.5 million, Germany- 82.4 million, UK – 60.2 million, France – 59.5 million, Italy – 58.1 million, Ukrain – 48.2 million.

The distribution of population depends to a large extent on the quality of land itself, which is very uneven.

The factors discouraging settlement are usually climatic or relief factors. The main factors are – cold, altitude, heat, drought, poor soils, in accessibility etc.

The factors encouraging settlements are- good land, flat or undulating terrain, the existence of mineral resources, a good climate suitable for a wide range of crops or a less equable climate suitable to the cultivation of specialized crops with good market etc. other factors include extension of roads, railways and other modes of transportation.

**Population explosion:**

The rapid growth of population is the major factor affecting the present and future national and regional development, but it is by no means the only population problem in the world today. The main problem is that of "population explosion".

Population explosion is a sudden increase in the rate of population growth due to a rapid fall in the mortality rate without a corresponding fall in the birth rate.

According to theory of demographic transition, every country passes through 2 stages of demographic transition.

I st stage, both birth and death rates are high and hence population remains more or less stable. The main features of this stage are backward economy where agriculture is the main occupation, low per capita income, low standard of living, inadequate and unbalanced diet, absence of educational opportunities and presence of social evils like polygamy, early marriages etc.

II nd stage, there is a rapid growth of population with the beginning of process of development, the living standards of people improve, education expands, medical and health facilities improve as a result of which death rate comes down. This is called population explosion.

Population explosion doesn't mean overpopulation or population density. Over population or population density is not the major problem. The problem arises when the economic development fails to maintain pace with population growth. The most important factors regarding population

are how fast population is growing, and most important is where it is growing.

Ex. Japan has a high population density but it ranked first on the human development index formulated by U.N.D.P. On the other hand low population density areas of Africa or South America are unable to support the existing population.

The, the size, distribution and structure of the population within a country must be viewed in relation to its natural resources and the techniques of production used by its population.

Effects of population:

1. Unemployment

2. Low living standard of people

3. Hindrance in the process of development of economy

4. Pressure on agriculture land

5. Low per capita income

6. Lack of basic needs like water supply and sanitation, education, health etc.

7. High crime rate

8. Environmental damage

9. Migration to urban area in search of job

10. Energy crisis

11. Over crowding of cities leads to dev3elopment of slums.

**16. Crazy Consumerism**

Consumerism as a social and economic order and ideology encourages the acquisition of goods and services in ever-increasing amounts. Early criticisms of consumerism occur in 1899 in the works of Thorstein

Veblen. Veblen's subject of examination, the newly emergent middle class arising at the turn of the 20th century, came to fruition by the end of the 20th century through the process of globalization.

In economics, "consumerism" refers to economic policies placing emphasis on consumption. In an abstract sense, it is the consideration that the free choice of consumers should strongly orient the choice by manufacturers of what is produced and how, and therefore orient the economic organization of a society.

Since consumerism began, various individuals and groups have consciously sought on alternative lifestyle, such as the " simple living".

Consumerism refers to the consumption of resources by the people.

Two types of conditions of population and consumerism exist.

1. People over- population: It occurs when there are more people than available supplies of food, water and other important resources in the area. Excessive population pressure causes cause degradation of the limited resources, and there is absolute, under- nourishment and premature deaths.

This occurs in less developed countries. Here due to the large number of people, adequate resources are not available for all.

So there is less per capita consumption although overall consumption is high.

2. Consumption over-population: This occurs in the more developed countries. Here population size is smaller while resources are in abundance and due to luxurious life-style per capita consumption of resources is very high. More the consumption of resources more is the waste generation and greater is the degradation of the environment.

## 5.3 ENVIRONMENTAL EDUCATION:

Education plays a very important role in dealing with the global issue. Environmental Education is an integral process, which

deals with man's inter- relationship with his (natural and manmade ) surroundings viz., relation of population, pollution,

resource allocation, resource depletion, conservation, technology ; urban and rural planning.

Environmental Education is intended to promote the awareness and understanding of the environment among the

citizens. Hence, Environmental Education is meant to bring about the required changes in knowledge, understanding

attitudes and skills pertaining to the environment, conservation and ecological balance. So, Environmental Education must

be considered as a solution for all environmental problems and the goal of Environmental

Education should be to improve and enhance the quality of life.

The objectives of Environmental Education are:

Awareness- to help individuals acquire an awareness of environment and its allied problems.

Knowledge- to acquire basic understanding of the environment

Skills- to acquire the skills for solving environmental problems. Participation-to develop responsibility regarding environmental problems to ensure appropriate action to solve those problems.

Importance of Environmental Education: The importance of environmental protection has long been recognized in our country. Article 51 (g) of the constitution states " It shall be the duty of every citizen to protect and improve the Natural environment including forests, lakes, rivers, wild life" etc..

Education about environment provides learners with the know-how on environment. Education for environment will be concerned about conservation, preservation and upgradation.

Conservation of Natural Resources: As the human population increases, greater demands are placed upon the available natural resources. Large areas of the earth are being converted for the exclusive use of man. Thus, many valuable natural resources, which were available yesterday are not seen today.

At present, world environment is suffering critical stress not only by utilization of natural resources but also with the

environmental damage inflicted by deforestation, species loss and climate change. So, a new environmental ethic with responsibility is required to recognize the earth's limited capacity of natural resources. This ethic must motivate the people to effect the needed changes.

The global population had already crossed 6 billions and may reach 8 billions by 2019 while the per capita availability of forests, pasture lands, crop lands etc will be decreased. Resources consumption in developed countries causes significant pollution problems, environmental degradation and resource depletion. For eg: an average US citizen consumes 50 times as much as the average citizen of India.

Hence, there must resources etc..be a holistic way of thinking regarding the management of land resources, water resources, forest

Over-exploitation of resources: The over-use or over-harvesting of plants, animals or natural resources threatens the Earth's biodiversity is called as over- exploitation.

Deforestation, Desertification, Extinction of species; Soil erosion; Fossil fuel depletion; Ozone depletion; increase of Green House Gases etc may arise from over-exploitation of natural resources.

**Urban Sprawl:**

The spreading of houses and shopping centers on undeveloped land near a city is called as Urban Sprawl. Basically the rapid growth and spread of big cities takes place where the consumption of land is faster than the population growth. The rapid growth of population causes environmental problems such as increase in pollution, smog, pollution from vehicles, increased water usage, energy consumption, and the loss of animals and their natural habitats. This has become a very serious problem because

these suburban areas take up a lot of land that could be otherwise used for Agriculture Urbanization refers to migration of population from rural regions to towns and cities. Man has always moved to new places in search of better opportunities. Hence, migration is not a new phenomenon. However, recent studies have shown a steep rise in urbanization in the late 19th and early 20th century. This sudden increase in urbanization ca n be attributed to Industrial Revolution, which provided better economic opportunities in the cities, due to setting up of factories and industries.

Cheaper land and housing costs in the suburbs as compared to urban centers t o settle in urban sprawl areas. There has been an increase the development of infrastructure like roads, water and electricity in the suburbs than in existing urban centers, thus adding benefits to urban sprawls.

There has been an increase in commercial lending practices that favor suburban development. Sprawls are characterized by low density populations and less traffic congestion. Higher property and business taxes in the cities have pushed businesses to the suburbs where taxes are generally low.

Effects: Sprawls have been criticized for increasing public costs where public money is being spent on redundant infrastructure outside the urban areas at the cost of neglecting the infrastructure in the cities that is either not utilized or underutilized.

Populations living in urban sprawls commute to cities in their automobiles. This has resulted in heavier traffic on the roads leading to traffic congestion, increase in air pollution and automobile related accidents.

Increasing dependence on automobiles has led the sprawl population to use their vehicles even for short distances. Such behavior is believed to have led to increase in obesity and hypertension, in the population living in sprawls than those in the cities.

Due to heavy dependence of people residing in sprawls on automobiles, city planners are compelled to spend more money on larger highways and

parking spaces. This is considered as an additional burden on the state treasury as this reduces the area of taxable land.

Urban sprawl is the later stage of urbanization and is an inevitable phenomenon. Just like every other process urban sprawl has its own pros and cons. However, the negative aspects of urban sprawls can be neutralized by monitoring their growth in a planned way, so that they are not a liability either to the society, economy or the environment.

**Human Health**: Health is the general condition of a person in all aspects. It is also a functional, metabolic efficiency of an organism.

Public health problems caused by environmental contamination and emerging infectious diseases are a growing concern worldwide. These public health threats are affected by the relationship between people and the physical, chemical and biological nature of our natural environments.

Vector borne and Zoonotic diseases; water contaminants; airborne contaminants Environmental threats to public health require marshalling of all our scientific knowledge and know-how to develop new solutions.

The Nation's natural science agency, play a significant role in providing scientific knowledge and information that will improve our understanding of the environmental contributions to disease and human health.

## 5.4 ENVIRONMENTAL ETHICS:

Ethics means the rules of conduct in a system of moral principles. It is a branch of philosophy. As such, every science or profession has its own ethics.

For example- environmental ethics forbid persons from activities that damage his environment like felling of trees.

For obvious reasons, persons who have love, respect and reverence for their environment only can have environmental ethics.

Environmental ethics tell us that we should leave as in-habitable world for our future generations.

Some of the suggestions:

1. Exploitation should stop.

Developed nations with one fourth of the global populations are consuming three fourths of the resources exploited from nature.

2. Emphasis on recycling of materials and renewable and pollution free power resources, should be the key note for the

future technology.

3. To promote harmony and give cheer and beauty to human life, the missing components in human growth, namely the aesthetic and spiritual aspects should be restored.

4. Environmental impacts of proposed activities by man, should be assessed by the right expertise.

- You should love and honor the earth since it has blessed you with life and governs your survival.

- You should keep each day sacred to earth and celebrate the turning of its seasons.

- You should not hold yourself above other living things and have no right to drive them to extinction.

- You should be grateful to the plants and animals which nourish you by giving you food.

- You should limit your offspring's because too many people will overburden the earth.

- You should not waste your resources on destructive weapons.

- You should not run after gains at the cost of nature, rather should strive to restore its damaged majesty.

- You should not conceal from others the effects you have caused by your actions on earth.

- You should not steal from future generations their right to live in a clean and safe planet by impoverishing or polluting it.

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- You should consume the material goods in moderate amounts so that all may share the earths precious treasure of resources.

World environment day is celebrated on 5th June.

The concept of 'ahimsa' (non-violence) in Buddhism and Jainism ensure the protection and conservation of all forms of life, thereby keeping the ecological balance of the earth intact.

## 5.5 CONCEPT OF GREEN BUILDING:

Green Building, is also known as Green Construction is the practice of creating structures such as design, construction, operation, maintenance, renovation etc throughout a building's life cycle. Green building helps to preserve the external environment and provides great benefits to humans through the use of safe building materials, efficient use of natural resources, human safety etc..

The most fundamental benefit of Green Building is that it is environmentally friendly and safe for people occupying the building. Its aesthetic design and well architectural features such as sufficient safe, proper layouts and pleasant lighting to people. While, elements such as clean air, clean water make it safe and beneficial to human health.

Another important benefit of Green Building is Energy efficiency which results in reduced energy consumption

for AC and Heating needs. Effective use of natural lighting, cool roof and wall panels which leads directly cost savings to the building owners.

The use of Solar Energy in green building can provide free electricity for the building owners. Solar panels can be

installed on the roof top of the building where the solar energy will be converted to electricity. Another way to generate

electricity is through the use of wind energy by setting in pathway of winds.

## 5.6 ECOLOGICAL FOOT PRINT

An ecological footprint is a measure of human demand on the Earth's ecosystems. It represents the amount of land and water area required to sustainably provide the resources that an individual, population, or activity consumes, and to absorb the waste and pollution it generates.

The ecological footprint includes the use of resources such as food, water, energy, and materials, as well as the impact of waste and pollution on the environment. It is calculated by adding up the area of land and water that is needed to produce the goods and services consumed by a person or a population, and then comparing it to the available biocapacity of the planet.

The ecological footprint is used as a tool for measuring sustainability and assessing the environmental impact of human activities. It can help individuals and organizations understand their impact on the environment, identify areas for improvement, and make more sustainable choices. By reducing our ecological footprint, we can help to reduce the pressure on the Earth's natural resources and ensure that they are available for future generations.

## 5.7 LIFE CYCLE ASSESSMENT (LCA)

**Life-Cycle Assessment** (LCA) – also called **Life-Cycle Analysis** – is a tool for examining the total environmental impact of a product

through every step of its life – from obtaining raw materials all the way through making it in a factory, selling it in a store, using it in

the workplace or at home, and disposing of it.

Life-Cycle Assessment is an *objective procedure* used to evaluate the environmental impacts associated with a product's entire life cycle, through the *quantitative determination* of *all exchange flows* between the product system and the ecosphere in all the transformation processes involved, from the extraction of raw materials to their return into the ecosphere in the form of waste. from the procurement of materials (these may be recycled instead of new) to their end for this product (*i.e.* disposal or recycling into a new product).

Historical perspective

1960s:Coca-Cola explores alternative containers besides the glass bottle.

Life-cycle analysis is performed for them by the Midwest Research Institute (MRI).

1970s: Oil embargos in the United States create concerns about energy supplies. The US Department of Energy commissions studies on "net energy analysis". They call their method "Resources & Environmental Profile Analysis" (REPA).

In 1974, the US EPA has MRI perform a new beverage container comparison.

In 1974, SPI compares different plastics.

In 1978, Franklin Assoc. performs a new LCA for soft-drink containers for Goodyear.

1980s "Green Movement" in Europe brings focus back on emissions and need to recycle. European industries study their pollution releases and begin comparing alternatives.

In 1988, Procter & Gamble has Franklin Assoc. compare laundry detergent packaging.

In 1989, Procter & Gamble has Franklin Assoc. compare surfactants

Notorious battle between cloth and disposable diapers:

1990 – The American Paper Institute finds disposable diapers to be preferable. (study by Franklin Associates)

1991 – The National Association of Diaper Services concludes the opposite. (study by Lehrberger & Jones)

1992 – Procter & Gamble reverses the conclusion once more. (study by A. D. Little)

Each time, additional considerations were brought in:

-indirect of paper production (increasing impacts of disposables)

-production of detergents (increasing impacts of washing cloth)

1992 – New study by Franklin Associates, concluding that the answer depends on whether one looks at energy or water or solid waste.


| ENVIRONMENTAL IMPACT | FOAM PLASTIC | CHINA/GLASS | PAPER |
|---|---|---|---|
| ENERGY CONSERVATION | ✓ VERY HIGH: Needs relatively little energy to make | POOR: Needs high energy to run kilns and wash for reuse | POOR: Requires high energy to run mills |
| WATER CONSERVATION | ✓ EXCELLENT: Little required | POOR: Needs large quantities to make and wash | POOR: Requires large quantities to make |
| WASTE-TO-ENERGY CONVERSION | ✓ EXCELLENT | NONE | POOR |
| RECYCLABILITY | ✓ TOTAL | PARTIAL | PARTIAL |
| LANDFILL CONTAMINANTS | ✓ NONE: Inert | ✓ NONE: Inert | Can contribute to methane gas and leachates |
| AIR POLLUTANTS WHEN PROPERLY INCINERATED | ✓ NONE | ✓ NONE: Doesn't burn | ✓ VIRTUALLY NONE |
| IMPACT ON OZONE LAYER | ✓ POSITIVE: Contains no CFCs | ✓ POSITIVE: Contains no CFCs | ✓ POSITIVE: Contains no CFCs |
| RELATIVE POCKETBOOK IMPACT (PRICE) | ✓ LOW | HIGH | HIGH |

STEPS in an LCA:

1. **Goal and Scope**: Select product or activity

Define purpose of study (comparison? improvement?) Fix boundaries accordingly

2. **Inventory Analysis**: Identify all relevant inputs and outputs Quantify and add (At this stage, data are in terms of energy consumed, emission amounts, *etc.*)

2. **Impact Analysis:** Determine the resulting environmental impacts

(At this next stage, the previous data are translated in additional cancer rates, fish kill, habitat depletion, *etc.*)

3. **Interpretation:** Use value judgment to assess and/or in relation to the objectives of the study.

Most often, an iteration occurs: Following the first interpretation, the product may be revised or the boundaries modified.

## 5.8 LOW CARBON LIFE STYLE.

A low carbon lifestyle is a way of living that reduces your carbon footprint or the total amount of greenhouse gases (GHGs) that are emitted as a result of your daily activities. GHGs are primarily responsible for climate change, and reducing them is a crucial step towards mitigating the impacts of climate change.

Here are some ways to adopt a low carbon lifestyle:

1. Reduce energy use: This can be achieved by turning off lights and electronic devices when not in use, using energy-efficient appliances, and minimizing heating and cooling.

2. Choose sustainable transportation: Walking, biking, and using public transport are low-carbon options. If you have to use a car, consider carpooling or using a hybrid or electric vehicle.

3. Reduce meat consumption: The production of meat, especially beef, has a high carbon footprint. By reducing meat consumption and choosing plant-based alternatives, you can significantly lower your carbon footprint.

4. Conserve water: Turn off the tap when brushing your teeth or shaving, use low-flow showerheads and toilets, and fix any leaks.

5. Reduce waste: Recycle, compost, and avoid single-use plastics to reduce the amount of waste that goes to landfills.

6. Choose renewable energy: Switching to renewable energy sources, such as solar or wind power, can greatly reduce your carbon footprint.

By adopting these lifestyle changes, you can reduce your impact on the environment and contribute to a more sustainable future.

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