1.1 ENVIRONMENT

The term 'environment' originated from the French word *environner* or *environ* meaning 'to surround.' From this etymology, environment means the things or events that surround something else. In other words, environment means the area in which something exists or lives.

Environment is defined as the social, cultural, and physical conditions that surround, affect, and influence the survival, growth and development of people, animals, or plants.

Environment includes everything around us. It encompasses both the living (biotic) and non-living (abiotic) components of the earth.
The environment consists of four segments. These are briefly discussed below:
Lithosphere It contains various types of soils and rocks on earth.
Atmosphere It is the blanket of gases surrounding the earth.
Hydrosphere It is composed of various water bodies on the earth. It includes the oceans, lakes, rivers, etc.
Biosphere It is composed of all living organisms and their interactions with the environment, viz. atmosphere, lithosphere, and hydrosphere. The biosphere is the earth's zone of air, soil, and water that can support life.

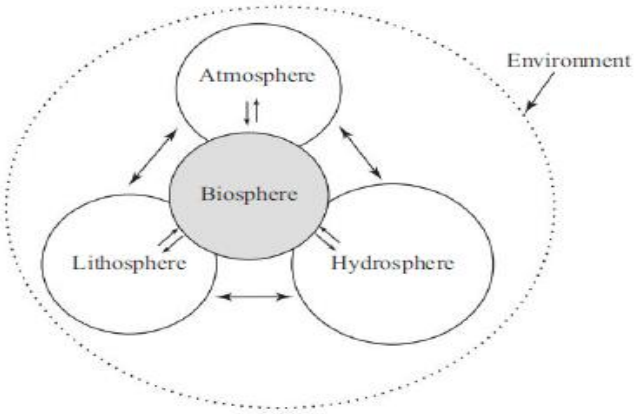


Fig. 1.1 *Concept of environment as a functional system composed of organised, interacting and independent elements*

1.1.1 Composition of the Lithosphere

The lithosphere (from the Greek *'lithos'* for "rocky" and *'sphaira'* for "sphere") is the rigid outermost shell of a rocky planet. The lithosphere includes the crust and the uppermost mantle, which constitute the hard and rigid outer layer of the earth.

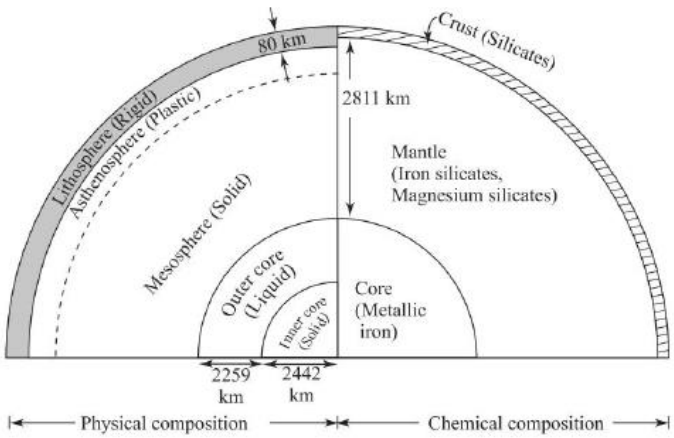


Fig. 1.2 *Internal structure of the earth*

There are two types of lithospheres.

(i) Oceanic Lithosphere It mainly consists of mafic crust and ultramafic mantle (peridotite). It is associated with oceanic crust.
(ii) Continental Lithosphere It is associated with continental crust. The oceanic lithosphere is denser than the continental lithosphere.

1.1.2 Atmosphere

The atmosphere is described as the blanket of suspended liquids, solids, and gases that envelope the earth.

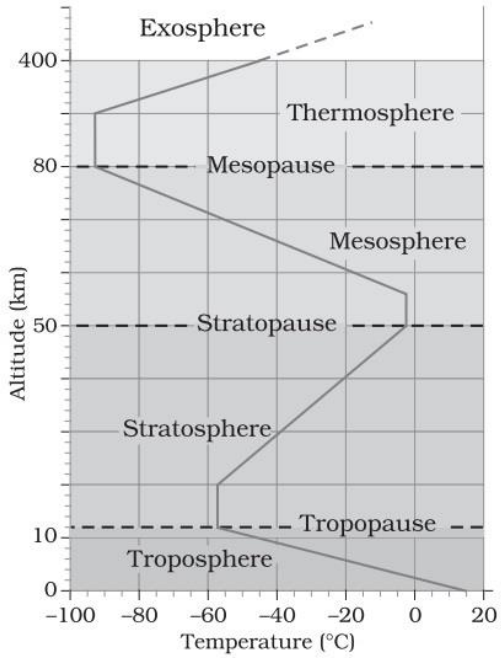
- The thickness of the earth's atmosphere is about 480 km. 99 percent of the thickness lies up to the height of 32 km from the earth.
- With increasing altitude, the air pressure decreases.
- The atmosphere has a mixture of gases that sustains life on earth.
- The earth's gravity helps hold the atmosphere in place.
- The major role of the atmosphere is to contain the entry of ultraviolet rays.

The composition of the earth's atmosphere is as mentioned below:

- Nitrogen — 78 percent
- Oxygen — 21 percent
- Argon — 0.93 percent
- Carbon dioxide — 0.04 percent
- Trace amounts of neon, helium, methane, krypton and hydrogen, as well as water vapour

There are five layers in the structure of the atmosphere depending upon temperature. These layers are:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere
- Exosphere



1.1.3 Hydrosphere

Hydrosphere comprises of all forms of water bodies on earth including marine (oceans, seas) freshwater (rivers, lakes, ponds, streams) and groundwater resources etc. It covers 71% of earth's surface. 97% of water found on Earth is in the oceans in the form of salt water. Only 3 % of water on Earth is freshwater. Out of this, 30.8% is available as groundwater and 68.9% is in frozen forms as in glaciers. Amount of 0.3% is available in rivers, reservoirs and lakes and is easily accessible to man.

1.1.2 The Biosphere

The biosphere is the earth's zone of air, soil, and water that can support life. It is a zone which reaches about 10 km into the atmosphere and down to the deepest ocean fl oor. Processes in the biosphere include life and death, and evolution and extinction. Within the biosphere, the basic unit of analysis or study is the ecosystem. Thus, the biosphere is the global sum of all ecosystems. The atmosphere forms a protective shell over the earth. The troposphere is the lowest layer and is only 12 km thick. It is the only part warm enough for us to survive in. The stratosphere is 50 km thick and contains a layer of sulphates which is important for the formation of rain. It also contains a layer of ozone, which absorbs ultraviolet light known to cause cancer.

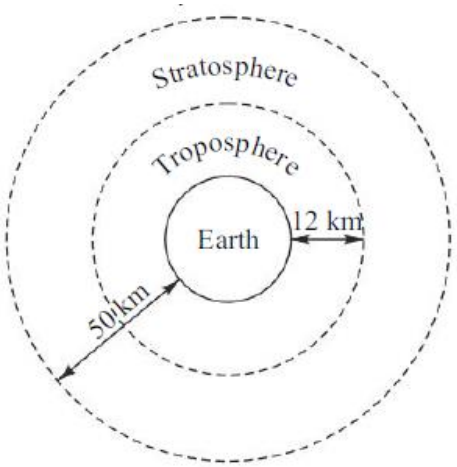


Fig. 1.3 *Atmosphere around the earth*

Types of Environment

The environment is divided into two parts which are as follows:
Geographical Environment
Man-Made Environment

Geographical Environment

Geographical environment refers to the terrestrial environment, which is made up of a variety of natural and environmental factors. It is the complement of direct interaction involving nature and human society, even though it developed independently of people. The geographical environment involves geology, the sciences of climatology, and biogeography. They are outward representations of human society's perceptions of the earth's landscape.
Because it interacts with nature, a geographical environment is often considered a natural environment. The natural environment includes the earth's surface, mountains, rivers, oceans, deserts, land, water, volcanoes, and so on.

Man-Made Environment

Because man is unable to live in his natural habitat, he creates some environmental circumstances to compensate. A man-made or human-made environment was created by humans. A social environment is considered a man-made environment.

There are two types of man-made environments which is as given below:
Inner Environment
Outer Environment

Inner Environment

The inner environment is a social environment that endures for as long as a civilization does. It has to do with rules, traditions, organisations, and institutions. It includes customs and folkways that can be found in any human community. Non-material culture, social heritage, and other terms are used to describe it. This legacy is necessary for human social life to thrive, and it is recognised to have an impact on an individual's life. The artificial environment, which is a modified form of the economic and physical environment, is considered two distinct components of the man-made environment.

Outer Environment

Humans have tried to alter the parameters of their physical environment through advancements in science and technology. This outer environment is the result of these changes, which include modern infrastructure in cities, our homes and associated amenities, our modes of communication and transportation, our resorts to conveniences and luxury, various types of electrical appliances, industry manufacturing luxurious commodities, and so on, all of which ultimately aim at civilization and urbanisation.
The inner and outer environments are inextricably linked and so inseparable.

Components of the Environment

The components of the environment are classified in terms of biotic and abiotic components based upon living components and non-living components respectively. It is from this component system that the study of the structure of ecosystems was evolved.

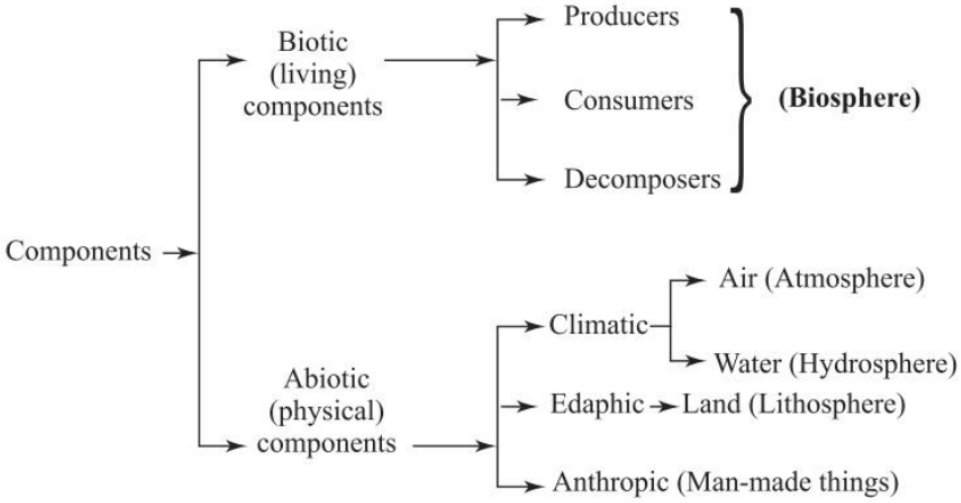


Fig. 1. 4 Components of the environment

Physical, biological, and cultural environments are the three distinct dimensions of the environment. The study of cultural environment (i.e., social environment, economic environment, and political environment) has been allocated to sociologists, economists and managers. Biologists and doctors oversee studying our biological environment [which comprises plants (flora), animals (fauna) and microorganisms]. Environmentalists take care of the physical environment (lithosphere, hydrosphere, atmosphere).

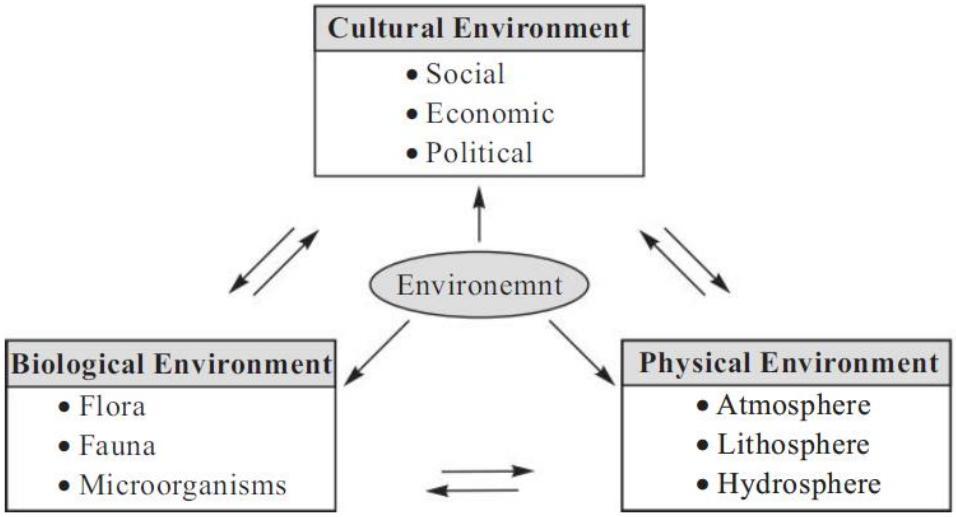


Fig. 1.5 Various types of environments and interactions between their various elements

Scope of Environmental Studies

The scope of environmental studies is so wide that it is related to every science and scientific aspects in general and biology.
The scope of environmental studies in numerous fields is given below:
(i) *Conservation and management of natural resources* (like forest resources, water resources, etc.)
(ii) *Conservation of biodiversities* (like conservation of genetic diversity, species diversity, ecosystem diversity, landscape diversity, etc.)
(iii) *Control of environmental pollutions* (like air pollution, water pollution, soil pollution, solid waste pollution, noise pollution, electronic waste pollution, e-pollution, etc.)
(iv) *Control of human population.*
(v) *Replacement* of development (like green revolution, urbanisation,) economic growth, (industrialisation, etc.) with *sustainable development.*

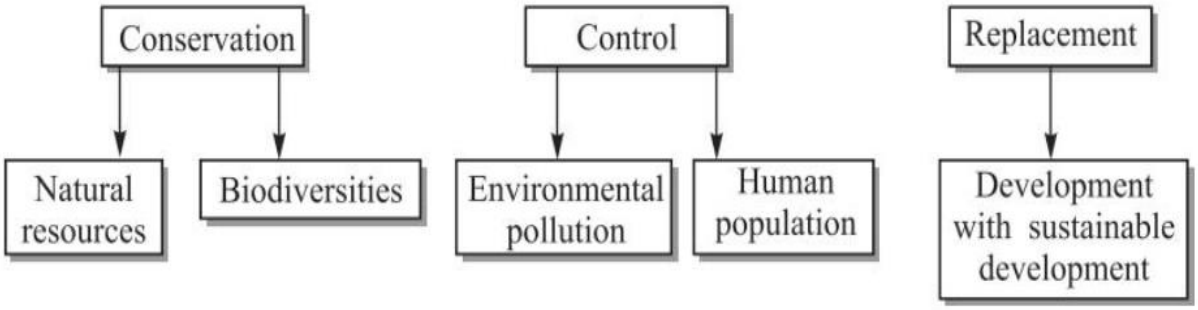
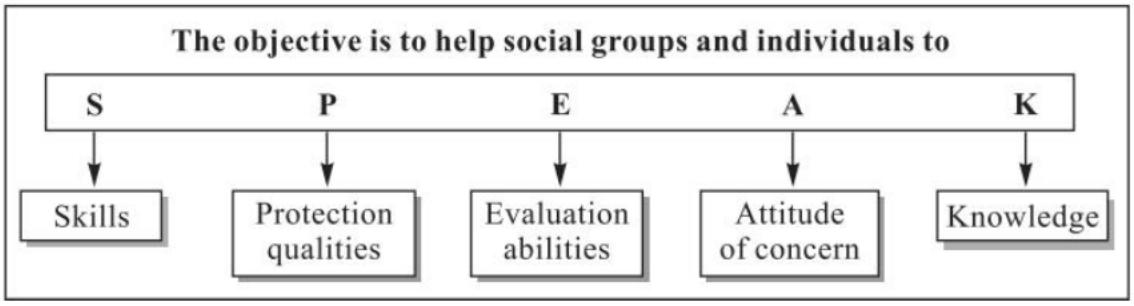


Fig. 1.6 Scope of environmental studies

Objectives of Environmental Studies

The objective of environmental studies is to help social groups and individuals acquire an awareness of the environment as a whole and its related problems. They should
(i) acquire the skills for identifying and solving environmental problems
(ii) participate in improvement and protection of the environment
(iii) develop the ability to evaluate measures for the improvement and protection of environment
(iv) acquire an attitude of concern for the environment
(v) gain a variety of experiences and acquire a basic understanding and knowledge about the environment and its allied problems.



Importance of Environmental Studies

For the survival of the present and future generations, environmental education is necessary.
The important benefits of environmental studies are the following:
(i) It directs attention towards the unlimited exploitation of environment (nature) by humans for greed or for the sake of development. Exploitation of nature has threatened the survival of all living organisms, including humans.
(ii) It generates concern for the changing environment, population explosion and throws light on the methods of solution.
(iii) It helps to understand different food chains and to find ways and means to maintain ecological balance.
(iv) It helps in the maintenance of healthy life. Through improved health of people, economic productivity gets increased.
(v) It imparts knowledge about conservation of energy and reducing material dependence

- by refusing to purchase things which are harming our environment
- by reusing a product number of times
- by motivating recycling of recyclable products

(vi) It helps in developing social responsibility towards protection of environment and control of environmental pollution.
(vii) It helps in appreciating and enjoying nature and working towards sustainable development.

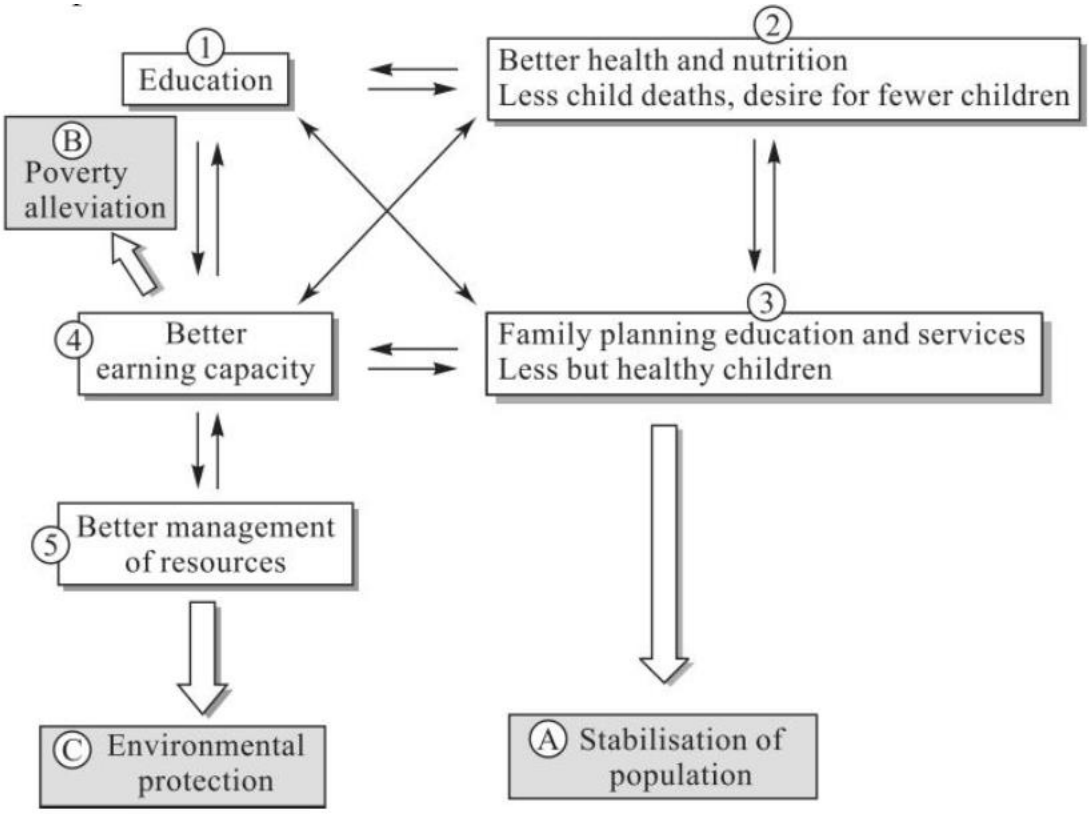


Fig. 1.7 Population stabilisation, poverty alleviation and environmental protection are mutually supportive of and dependent on one another

NEED FOR PUBLIC AWARENESS

Humans are responsible for depletion of natural resources; degradation of the vital life-supporting systems (like air, water, soil, etc.); ecological imbalance; deteriorated environment, etc. Solid waste disposal, oil pollution, water pollution, air pollution, Itai-Itai disease, Minamata disease, Chernobyl disaster, Bhopal gas tragedy, smog, etc., are some of the examples which are threatening human survival

To get rid of these problems, environmental awareness is necessary. It ensures that everyone knows about the consequences of his/her activities on nature.

To protect global environment for sustainable development, we should do the following:

(i) **Preserve Forest Cover** Humans should minimise cutting of trees and using timber for aesthetic pleasure such as decoration of drawing rooms.
(ii) **Preserve Natural Resources** Humans should not unnecessarily and exhaustively extract natural resources such as mineral resources, water resources, etc.
(iii) **Conserve Energy** Humans should not harness too much energy from burning of fossil fuels.
(iv) **Maintain Ecological Balance** Humans should work to create synergy between green revolution and industrial evolution by compulsory growing green belts around industrial areas, maintaining wildlife sanctuaries and national parks.
(v) **Practice Green Technology**: Everyone from a farmer in the village to a policy planner in the government should use green technology that incorporates

(a) treatment of air emissions,
(b) treatment of waste waters,
(c) waste reduction, waste, or emission management, and
(d) use of nonconventional, renewable energy resources like solar energy on priority, etc.

ECOLOGY

The term ecology is derived from the Greek word Oikologie. Literally, Oikos means 'home or surroundings and logos means 'study'. Thus, ecology is the study of nature. Ecology can be defined as "the study of interactions between an organism and its physical environment; the relationship between animals and plants and how one species affects another."

Classification of Ecology

Ecology can be classified as:

Based on study area:

1. Autecology
2. Synecology

Autecology:

Autecology is also known as Species ecology. It is the study of an individual species and its population.

Synecology:

Synecology is also known as ecology of communities.

- Population Ecology
- Community Ecology
- Ecosystem Ecology

Based on environment / habitat:

1. Aquatic Ecology
2. Terrestrial Ecology

Aquatic Ecology

- Marine Water Ecology
- Ocean Ecology
- Deep Sea Ecology
- Estuary Ecology
- Freshwater Ecology
- Lectic (Running water) Ecology
- River Ecology
- Stream Ecology
- Spring Ecology
- Lentic (Standing water)
- Pond Ecology
- Lake Ecology

Terrestrial Ecology

- Grassland Ecology
- Forest Ecology
- Desert Ecology

Based on advancements in the field of Ecology

- Productive Ecology
- Population Ecology
- Community Ecology
- Ecosystem Ecology
- Microbial Ecology
- Radiation Ecology
- Pollution Ecology
- Space Ecology

ECOSYSTEM

"An ecosystem is defined as a natural unit that consists of living and non-living parts which interact to form a stable system."
An ecosystem is generally an area within the natural environment in which physical (abiotic) factors of the environment, such as rocks and soil, function together along with interdependent (biotic) organisms, such as plants and animals, within the same habitat to create a stable system. It possesses all the characteristics required to sustain life.

TYPES OF ECOSYSTEMS

There are several ecosystems working at micro and macro levels in the world.
The world's smaller ecosystems are broadly divided into **natural and artificial** type ecosystems.

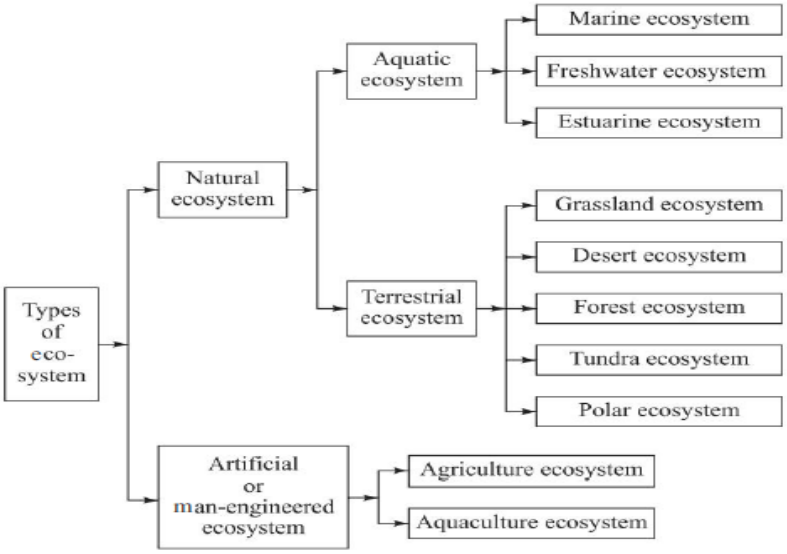


Fig. 1.8 Classification of ecosystems

Natural Ecosystems

They operate by themselves under natural conditions without any interference by humans. Broadly they are sub classified into terrestrial and aquatic ecosystems.

Terrestrial Ecosystem

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

- Forest Ecosystem
- Grassland Ecosystem
- Tundra Ecosystem
- Desert Ecosystem
- Polar Ecosystem

- **Forest Ecosystem**

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

- **Grassland Ecosystem**

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

- **Tundra Ecosystem**

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

- **Desert Ecosystem**

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

- **Polar ecosystem**, complex of living organisms in polar regions such as polar barrens and tundra.

Aquatic Ecosystems

They are known by the type of habitat. They can be of estuarine, marine, and freshwater types of ecosystems.

The freshwater ecosystems can be of standing freshwater ecosystems (or **lentic ecosystems**) or running freshwater ecosystems (or **lotic ecosystems**).

Examples Ponds, lakes, etc., are examples of lentic ecosystems and rivers, springs, etc., are examples of lotic ecosystems.

Marine ecosystem covers the largest surface area of the earth. Two third of earth is covered by water and they constitute of oceans, seas, intertidal zone, reefs, seabed, estuaries, hydrothermal vents and rock pools.

Estuarine ecosystems. These are areas where both ocean and land contribute to a unique ecosystem

Artificial Ecosystems

These ecosystems are controlled and manipulated by humans. These are created by humans in order to fulfil certain needs.

Broadly, they are subclassified into the following two types:

i. **Agriculture ecosystem-** Agroecosystems are the ecosystems supporting the food production systems in farms and gardens. As the name implies, at the core of an agroecosystem lies the human activity of agriculture

The 7 steps involved in agricultural practices are mentioned below:

- Ploughing.
- Sowing.
- Adding nutrients.
- Irrigation.
- Protecting plants.
- Harvesting.
- Storage.

ii. **Aquaculture ecosystem**- The propagation and husbandry of aquatic plants, animals, and other organisms for commercial, recreational, and scientific purposes

Differences between Natural and Artificial Ecosystems

Natural ecosystems	Artificial ecosystems
(i) Polyculture systems	(i) Monoculture system
(ii) Stable ecosystems	(ii) Fragile ecosystems
(iii) Less productive in terms of yield of grains, milk, fish, or meat	(iii) Highly productive as they are given increased supply of energy in the form of labour, extra nutrients, fossil fuels, fertilisers, pesticides, etc.
(iv) Pollution free	(iv) Generate lots of pollutants.
(v) Examples: Aquatic ecosystems and terrestrial ecosystems	(v) Examples: Agriculture ecosystems and aquaculture ecosystems
(vi) Functions • Air purification	(vi) Functions

• Water purification	• To supply large quantities of grains, etc. • To supply large quantities of fish, meat, milk, etc.

Structure of an Ecosystem

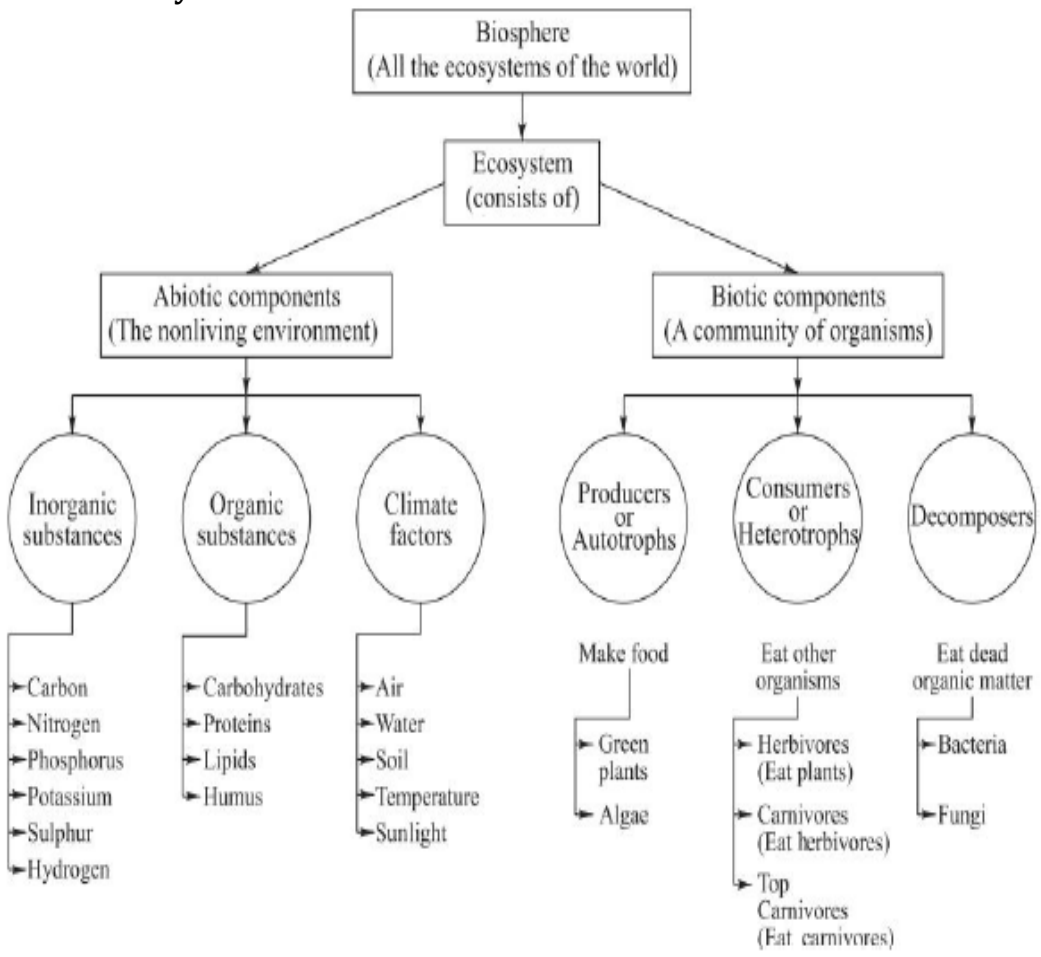


Fig. 1.9 Structure of an ecosystem

(A) Abiotic Components

All the non-living components of the environment constitute the abiotic components. It includes:

- ***Inorganic substances*** which are involved in mineral (nutrient) cycles. Examples: C, N, P, K, S, H, etc.
- ***Organic substances*** present in the biomass or in the environment. They form the living body and influence the functioning of the ecosystem. Examples: Carbohydrates, proteins, lipids, humus, etc.
- ***Climate factors*** having a strong influence on the ecosystem.

(i) Water Plants and animals receive water from the soil and the earth's surface. Water is the medium by which mineral nutrients enter and are distributed in plants. For the survival of animals, water is necessary.

(ii) Soil Soil provides nutrients and water, a structural growing medium for organisms.

(iii) Atmospheric Air Within ecosystems, the atmosphere provides oxygen for respiration of organisms and carbon dioxide for photosynthesis in plants.

(iv) Sunlight Sunlight is necessary for photosynthesis. It is used to heat the atmosphere in ecosystems.

(B) Biotic Components

All the living components of the environment constitutes the biotic components. Depending on their self-food producing capability, biotic components are of following types.

(i) Producers or Autotrophic Components Producers are self-nourishing organisms (so they are called autotrophs). They contain chlorophyll and can convert carbon dioxide and water, in the presence of sunlight into carbohydrates through photosynthesis. In the process, they give out oxygen.

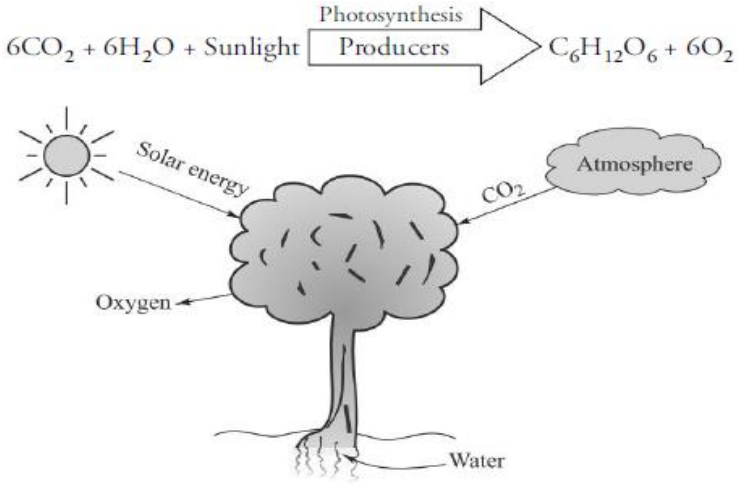


Fig. 1.10 Process of photosynthesis

Autotrophs are of the following two types:

(a) Photoautotrophs These are the producers who fix energy from the sun and store it in complex organic compounds. Examples Green plants, some bacteria, algae.

(b) Chemoautotrophs (Chemosynthesizers) They are bacteria that oxidise reduced inorganic substances (typically ammonia and sulphur compounds) and produce complex organic compounds. Example: Nitrifying bacteria in the soil underground.

(ii) Consumers (or Heterotrophic Components) Consumers depend on producers to obtain their energy for survival. They utilise, rearrange, and decompose the organic matter produced by autotrophs. Consumers are classified as herbivores, carnivores and top carnivores depending on their food habits.

(a) Herbivores (or Primary Consumers) They feed on green plants (autotrophs) to obtain energy for survival. Seed-eaters are also known as granivores. Fruit-eaters are also known as frugivores.
Example: Grasshoppers, rabbits, goats, cows, horses, etc.
(b) Carnivores (or Secondary Consumers) They feed on primary consumers.
Example: Lizard, fox, hawk, etc.
(c) Top Carnivores (or Tertiary Consumers) They eat the flesh of both carnivores and herbivores and are not killed or eaten by other animals.
Example: Lions, tigers, vultures, etc.

Some animals eat both plants and animals. They are called **omnivores.**
Some examples of omnivores are human beings, monkeys and bears.
Some animals feed on dead animals. They are called **scavengers.**
Vultures are the most common scavengers.

(iii) Decomposers The decomposers are also known as saprotrophs (i.e., sapros = rotten; trophs = feeder). They feed on dead organic matter (from producers and consumers). They transform complex organic compounds back into simple inorganic substances like CO2, H2O, phosphates, sulphates.
Example: Bacteria, fungi, other microbes, etc.
Fallen leaves, parts of dead trees, and faecal wastes of animals are termed **detritus.**
The consumers that feed on detritus are known as **detrivores.**
Example: Ants, termites, earthworms, crabs, etc.

Function of an Ecosystem

The functions of the ecosystem are as follows:

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

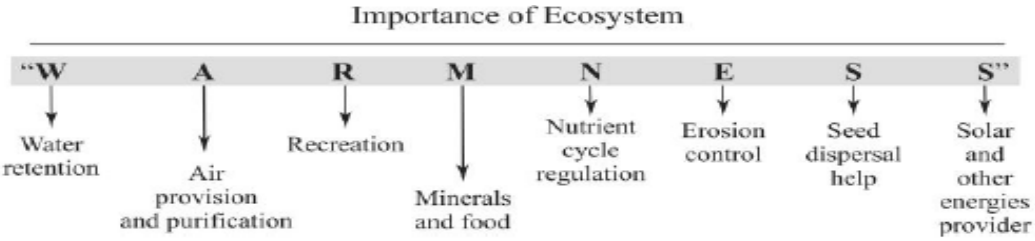
So the functional units of an ecosystem that work together in an ecosystem are:

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

Importance of an Ecosystem

An ecosystem provides number of services for the healthy survival of humans. For example:
(i) An ecosystem helps in water retention, thus facilitating a more evenly distributed release of water.
(ii) An ecosystem provides air and does its purification.
(iii) An ecosystem provides recreation for us via eco-tourisms facilitating the enjoyment of nature.

(iv) An ecosystem provides materials like minerals and food. (v) An ecosystem regulates nutrient recycling and waste.

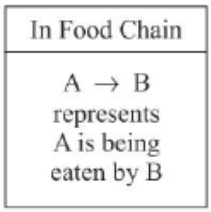


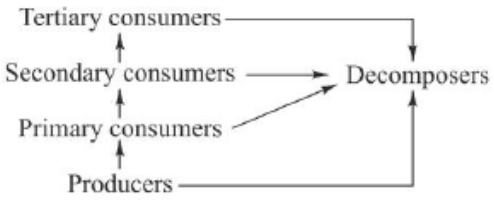
(vi) An ecosystem helps in erosion control, soil building and soil renewal.
(vii) An ecosystem helps in seed dispersal.
(viii) An ecosystem gives us solar energy (that accounts for 99% of the total energy used on earth). It also gives us

- Renewable energy like biofuels, and
- Non-renewable energy like fossil fuels.

FOOD CHAIN

A food chain refers to the order of events in an ecosystem, where one living organism eats another organism, and later that organism is consumed by another larger organism. The flow of nutrients and energy from one organism to another at different trophic levels forms a food chain.





Examples of food chain:

1. Grass→ Grasshopper→ Frog→ Snake→ Hawk.
2. Grass→ Mouse→ Snake →Hawk.

Types of Food Chains

Food chains are broadly of the following two types:

(i) Grazing Food Chain This food chain starts with green plants (primary producers) and goes to herbivores and on to carnivores.

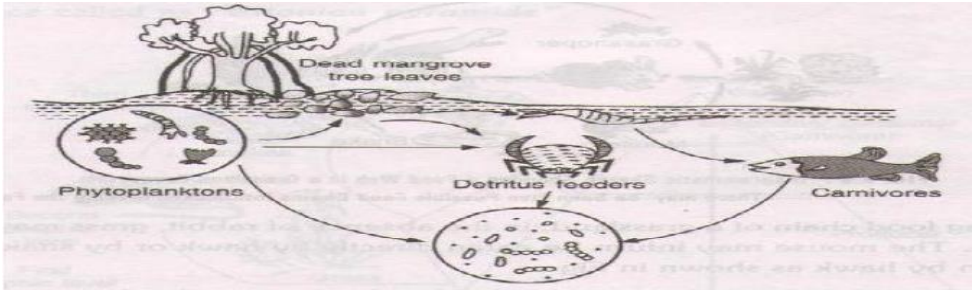
1. Phytoplankton's→ Zooplanktons →Small fish→ Tuna.
2. Phytoplankton's→ Zooplanktons→ Fish→ Man.
3. Grass→ Rabbit→ Fox→ Tiger.

(ii) Detritus Food Chain This food chain starts from dead organic matter (dead leaves/ plants / animals) and goes to Herbivores and on to Carnivores and so on.

Leaves or dead plants→ Soil mites→Insects→Birds

Dead organic matter→ Bacteria → Insects.

Dead leaves → Algae→ Fish→ Man.

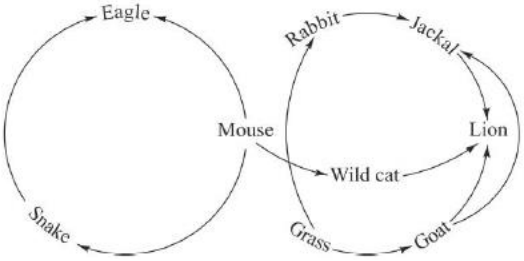


FOOD WEB

Food web is a net work of food chains where different types of organisms are connected at different trophic levels so that there are a number of options of eating and being eaten at each trophic level. Several interconnected food chains form a food web.

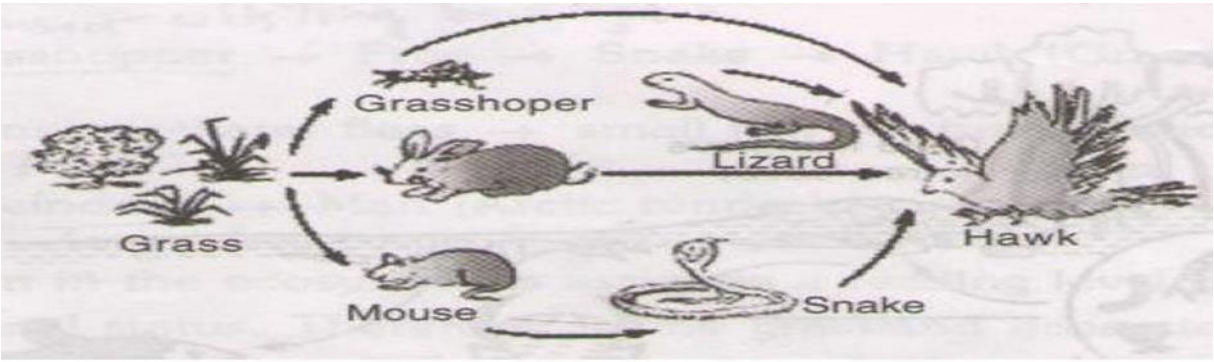
Food chains overlap, because most consumers feed on multiple species and in turn, are fed upon by multiple other species. Thus, we have a complex network of interconnected food chains called **a food web.**

For example, a snake might feed on a mouse, a lizard, or a frog. In turn, the snake might be eaten by a bird or a badger.



Food web in a forest

1. Grass→ Grasshopper→ Hawk
2. Grass→ Grasshopper→ Lizard→ Hawk
3. Grass→ Rabbit→ Hawk
4. Grass→ Mouse→ Hawk
5. Grass→ Mouse→ Snake→ Hawk



ECOLOGICAL PYRAMID

Ecological pyramids were first studied by a British ecologist Charles Eltan (1927). An ecological pyramid is a graphical representation of the relationship between the different living organisms at different trophic levels. In an ecological pyramid the huge number of tiny individuals form at the base and a few large individuals occupy the top. This formation is known as ecological pyramid.

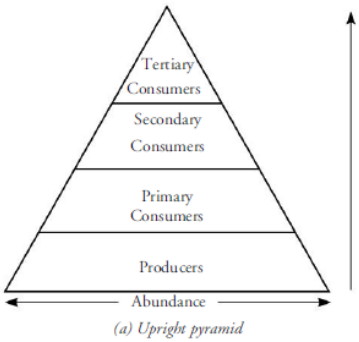
Hence, all producers (micro & macro plants) belong to the I trophic level; all primary consumers belong to II trophic level and organisms feeding on these consumers belong to the III trophic level and so on.

The ecological pyramids are of three types. They are:

1. **The pyramid of Numbers** (showing population).
2. **The pyramid of Biomass** (showing total mass of organisms).
3. **The pyramid of energy** (showing energy flow).

1.Pyramid of Numbers

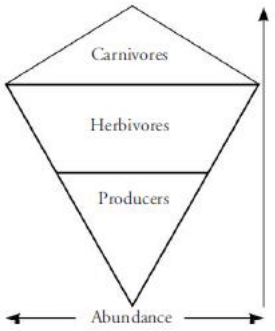
The pyramid of numbers represents the number of individuals at each trophic level. The shape of a pyramid of numbers can be upright, partly upright and inverte(ecosystem.



(a) Upright pyramid

a) Aquatic and Grassland Ecosystem

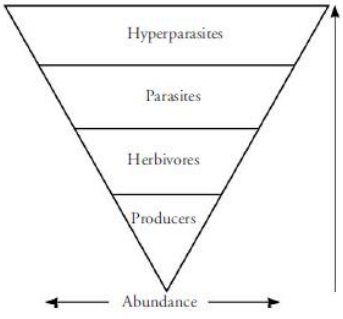
In aquatic and grassland ecosystems, the number of producers is always more than that of primary consumers. Thus, the producer organisms remain in abundance near the base of the food chain and the consumers gradually decrease in number towards the apex. As a result, the shape of the pyramid is upright



(b) Spindle shaped

b) Forest Ecosystem

In a forest ecosystem, there are fewer number of producers that support a greater number of herbivores who in turn support a lesser number of carnivores. The shape of the pyramid of numbers is partly upright or spindle type



(c) Inverted pyramidal shaped

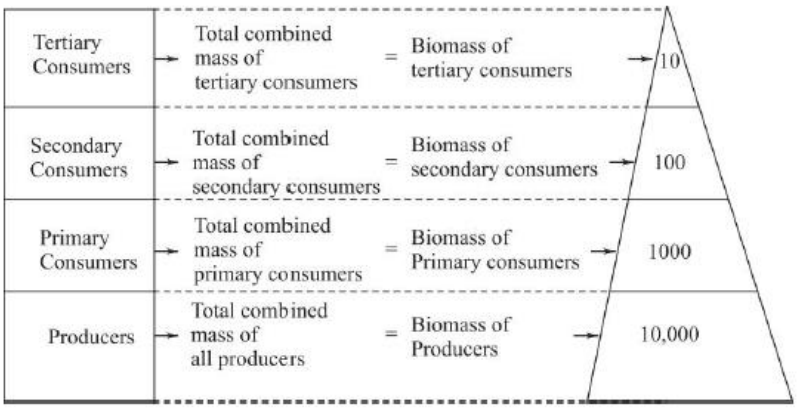
c) Parasitic Food Chain

In a parasitic food chain, one primary producer supports numbers of parasites which again support still more hyperparasites. The pyramid of numbers is inverted in shape because the producers are least in number and the predators are greater in number as we move up the food chain

2.Pyramid of Biomass

The amount of organic matter present in environment is called bi[illegible]. In pyramids of biomass, the relationship between different trophic levels is mentionedin terms of weight of organisms**.** The pyramid may be upright for grassland ecosystem and inverted for pond ecosystem.

Each tropic level contains a defi nite amount of biomass. As we move up trophic levels, biomass decreases drastically. There is 90 to 99 per cent loss of biomass at each level. This is known as the pyramid of biomass.

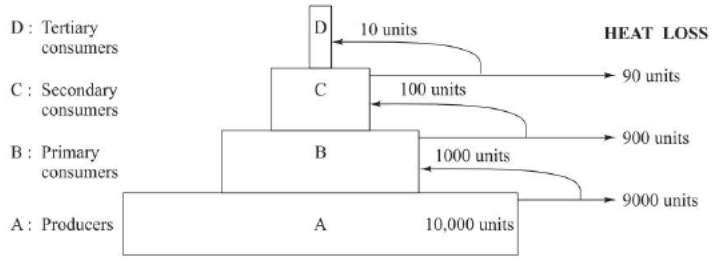


Depicting biomass relationship graphically at successive trophic levels gives rise to a biomass pyramid

3.Pyramid of energy

The amount of energy trapped per unit time and area at different trophic levels of a food chain with producers forming the base and the top carnivores at the apex is called pyramid of energy

Flow of energy in an ecosystem takes place through the food chain. The main source of energy for most ecosystems is the sun. Solar energy is trapped by producers. They store it as carbohydrates, proteins, and fats. When primary consumers eat the producers, the energy also moves up the trophic level. During this transfer, about 90% of the energy is lost as unusable heat to the environment. We have an upright pyramid of energy flow as we move up the trophic levels, and the amount of usable energy available at each stage declines.



Pyramid of energy flow

The flow of energy through the various components of the ecosystem is unidirectional and continuous.

(i) First Law of Thermodynamics

Energy can never be created or destroyed, but can be converted from one form to another.

(ii) Second Law of Thermodynamics

Transformations of energy always result in some loss or dissipation of energy.

MAJOR ASPECTS OF HUMAN ACTIVITIES

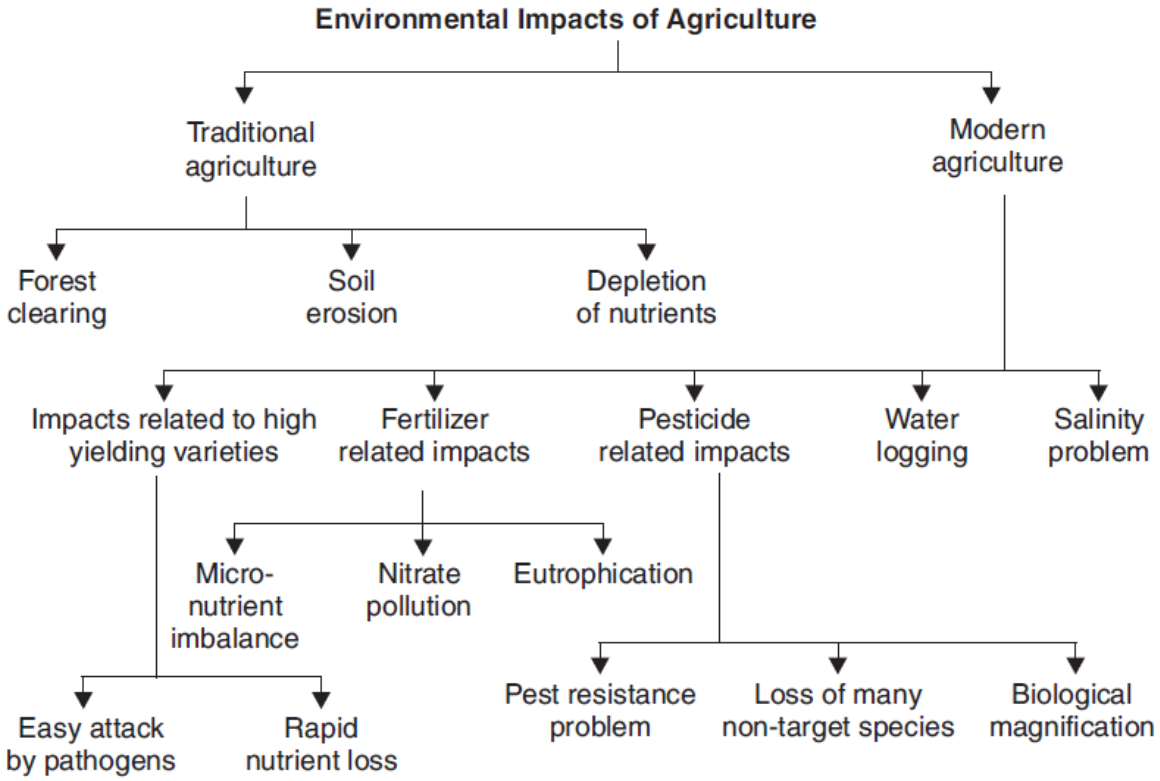
FOOD

1. There are thousands of edible plants and animals over the world, of which only about three dozen types constitute the major food of human beings.
2. With increasing population, the demand for crops has increased at a rate that has laid a lot of stress on our land resources. As a result, forests have been cleared to create agricultural lands.
3. During the last 50 years world grain production has increased almost three times, thereby increasing per capita production by about 50%. But, at the same time population growth increased at such a rate in LDCs (Less developed countries) that it outstripped food production.
4. The Food and Agriculture Organization (FAO) of the United Nations estimated that on an average minimum caloric intake on a global scale is 2500 calories/day.
5. People receiving 2000–2200 calories/ day are said to be **undernourished**, who suffer from various deficiencies and health problems.
6. People having deficiency of proteins are said to suffering from **malnutrition**. About 15–20 million deaths occur annually due to malnutrition.
7. **Overnutrition** results from eating too much, taking many vitamins or replacement leading to overweight and obesity.
8. Every year 40 million people (fifty per cent of which are young children between 1 to 5 years) die of undernourishment and malnutrition.

SHELTER

1. With increasing population, there is also increasing pressure on finite land resources for housing. Shelter for humans or habitat development on this earth has largely taken place within about 5% of land area, which supports more than half of global population.
2. Both overcrowded unplanned urban settlements and unhygienic, underdeveloped rural settlements pose big challenges for the present and future generations.
3. Fast depletion of natural resources, shrinking land, rising pollution levels and associated health problems have forced us to re-look at the structure and design of buildings by introducing environmental approach to buildings.
4. There is an urgent need to apply the principles of sustainability to **'built environment'**.

AGRICULTURE



INDUSTRIALISATION

1. The most serious impact of industrialization is environmental pollution that has affected our land, water, and air. Major rivers of the world have suffered colossal losses due to water pollution. Many important rivers have been converted into open severs.
2. Even the groundwater is getting polluted due to illegal drilling of industrial waste water.
3. Toxic gases and particulate matter from industrial emissions and vehicular exhaust have polluted the atmosphere.
4. Release of greenhouse gases into the atmosphere has caused enhanced global warming.
5. Release of CFC's has been responsible for depletion of protective ozone layer in the stratosphere, which makes our earth more prone to exposure of the harmful UV radiations.
6. Release of oxides of nitrogen and sulphur from power plants and industries is responsible for causing acid rain in many regions of the world.
7. Contamination of the land with toxic heavy metals is rendering it unproductive.

HOUSING

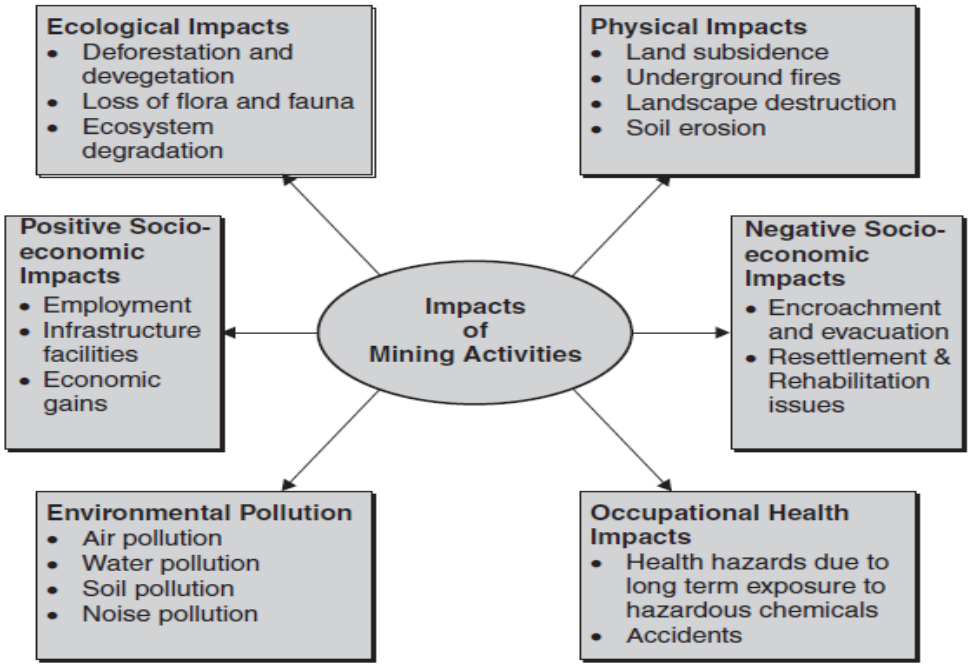
1. With increasing population growth, there has been a global shift of population from rural to urban centres. According to population Reference Bureau, 48% of the world population lives in urban areas now.
2. Generally, towns with populations of 2000 or more are considered urban. Urban population is much higher (75%) in developed nations and about 38% of total population of developing nations lives in urban areas.
3. Housing and infrastructure facilities is a major challenge in urban areas, where space is limited.
4. Provision of water, sewage system, educational and medical facilities, transportations and housing to the influx of people from rural to urban areas is a big task.
5. Energy consumption and related impacts.
6. Physical degradation of environment and loss of top fertile soil.
7. Depletion of natural resources and biodiversity due to deforestation.

TRANSPORTATION

Some of the major, environmental effects of transport on environment are as follows:

1. Conversion of vast areas of agricultural land and wild-life habitats have been converted into sub-urban housing, as greater mobility has been made possible with increased automobile use.
2. Land is being used for building highways and there is loss of fertile top soil during construction of highways.
3. Landslide occurrence has increased as construction of roads clears large forested areas in the fragile mountainous areas.
4. Automobiles lead to air pollution due to vehicular emissions like carbon monoxide, lead (in case of leaded petrol), and volatile organic compounds.
5. Noise pollution is a major problem arising due to transport activities.
6. Many aircrafts are releasing oxides of nitrogen that are greenhouse gases, responsible for climate change.
7. Widespread use of private automobiles has enormously increased the consumption of petrol, which has limited reserves.

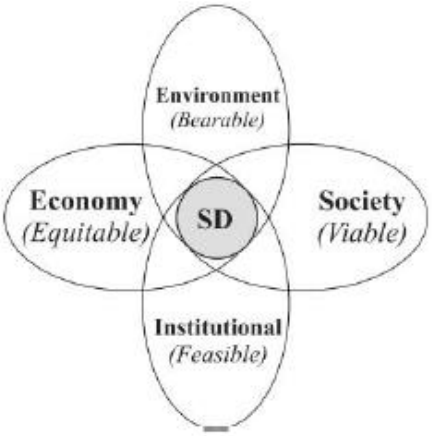
MINING



Impacts of Mining

SUSTAINABLE DEVELOPMENT

Sustainable development means meeting the needs of the present without compromising the ability of future generations to meet their own needs.
Sustainable development is a continuous process. To be sustainable is a constant challenge for humanity.



Pillars of Sustainable Development (SD)

Social development, economic development and environmental protection are equivalent objectives of sustainable development.

Objectives of sustainable development

Major Obstacles in the Path of Sustainable Development

The major obstacles in the path of sustainable development are
(i) Population explosion
(ii) Absence of adequate political and industrial willingness for sustainable future
(iii) Non-availability of eco-friendly and resource efficient technology
(iv) Non-availability of sufficient funds
(v) Insufficiency of environmental awareness, non-conservation of resources
(vi) Absence of appropriate land-use planning
(vii) Absence of strict environmental laws and practices; absence of practice of effective methods of pollution control

EIA

EIA full form is Environmental Impact Assessment. In simple terms, the meaning of EIA is that it is a process through which an environmental impact of a proposed development is evaluated. While undertaking Environmental Impact Assessment (EIA), the inter-related socio-economic, cultural, and human-health impacts are considered.

Stages of the EIA process

If an EIA is required, an Environmental Assessment Impact Report will be written and submitted with the application for development consent. The public will have the chance to comment. This makes sure you're given a chance to be involved in decision making

Stage	What's involved
1. Screening	Deciding if an EIA is required
2. Scoping	Deciding what needs to be covered in the assessment and reported in the 'EIA Report'
3. Preparing the EIA Report	The EIA report has to include the likely significant environmental effects of the development
4. Making an application and consultation	The EIA Report and development application must be publicised (including electronic advertisement), interested parties and the public must be given an opportunity to give their views on it
5. Decision making	The EIA Report and any comments made on it must be taken into account by the competent authority before they decide whether to give consent for the development. The decision notice has to be published
6. Post decision	The developer starts any monitoring required by the competent authority.