

CHAPTER- 1

Environment

INTRODUCTION

According to the constitution of India (Article 51A, g), it shall be one of fundamental duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures.

The state of environment observed to be declined in quality world over since 1960 due to population growth, loss of vegetation, loss of biodiversity and climate change UN Conference on the Human Environment held Stockholm in June 1972.

UN Conference on the Human Environment and Development (UNCED) held in Rio de Janeiro in 1990, where all members agreed of protect the environment from further degradation of air, soil, water and biosphere and to improve social, economic development to ensure sustainable development. In 2002, at world summit on sustainable development in Johannesburg world members of UN reaffirmed their commitment (a collective effort necessary at local, national, regional and global level) to ensure economic, social development and environmental protection.

Biological environment includes parts of atmosphere, hydrosphere and lithosphere. Environment thus includes air, water, land and human beings other living creatures, plants, micro-organisms and property. Environmental pollution means presence of solid, liquid or gaseous substances in such concentration as may be injurious or tend to be injurious to environment.

Environment may be defined as the place in which an organism lives and also includes the conditions under which it survives. Environment includes water, air and land and the inter-relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organisms and property. From the dawn of civilization man has been trying to use the natural resources for making life easier and comfortable. Science has helped him to understand the nature of animate and inanimate objects around him. Acquisition of knowledge helped him to understand the physico-chemical laws/principles which govern the behaviors of living and non-living things and their inter-relationship. The beneficial application of science to mankind is called technology. Application of technology in industry greatly modified the life style of man in twentieth century.

It is now known that all forms of life is made up of protoplasm and carry identical processes but they live in totally different surroundings or environments. There exists a critical relationship between living things and its physical environment. Biosphere is the space (area) near the earth's surface which encompasses all living organisms. This region includes parts of atmosphere, hydrosphere and lithosphere. *Environment* of an organism is its surrounding media. *Ecology* is the relationship of an organism to its environment. *Ecosystem* is the functioning of living and non-living components of environment.

The principal physical factors of an environment are: soil conditions, temperature, inclination of the sun (light), water, atmospheric conditions and topography.

The application of technology in twentieth century not only brought benefits but also brought decline in the environmental quality and threatening to effect the available natural resources for the present and future generations besides causing damage to the health of living being and extinction of some species of life. Thus technology proved to be both Boon and Bane to life on earth. The UN Conference on Human Environment was held at Stockholm in June 1972 to take appropriate steps for the protection and improvement of human environment. This step is required because the state of environment has substantially declined in quality due to increasing pollution, loss of vegetation cover and loss of biological diversity. There has been excessive concentration of harmful chemicals in the ambient atmosphere and in food chains. Environmental accidents risk increased and threatened the life supporting systems. The first World Environment Day Observed in 1973.

All living organisms are composed of carbon, Oxygen, Nitrogen, Hydrogen, which are also the basic elements of water and air-shells of the earth. A large part of the living matter contained in green plants, which entrap solar energy and make complex compounds by photosynthesis process. The main sources of plant feeding are carbon dioxide and water. Plants use about 2% of insolation (incoming solar radiation) for photosynthesis process, about 7w/m^2 is consumed by plants.

Plant kingdom provides about 10^{17} kg of biomass annually and an equal amount of oxygen. An average size of tree supplies about 3500kg of oxygen per year which is sufficient for three people. Because of this plant kingdom is also called the lungs of the earth. On an average a man requires about 3.13 kg oxygen or 15 kg of air per day.

The total mass of CO_2 in the atmosphere is about 0.23×10^{16} kg while the mass of CO_2 in the ocean water is about 1.4×10^{17} kg, which is more than 60 times the mass of CO_2 in the atmosphere. Sea water plays a peculiar role in respect of dissolved natural gases of N, O_2 , CO_2 and H_2S . these gases are

closely related to living matter on the land and in the sea. Carbon dioxide enters into the atmosphere by human and animal breathing decay and burning of materials containing carbon and volcanic activity. More than 90% of the earth CO₂ is dissolved in sea waters. The stability of CO₂ in sea changes with temperature.

A jet airliner consumes 6-9 tons of oxygen in one hour, 25-50 thousand hectares of forest expels (gives) 50-75 tons of O₂ in 8 hours.

1.1 MAN AND ENVIRONMENT

Earth environment affects the well being of man, animal and plants world over. Compared to other species of life, man is more advanced in intellect and hence it is the duty of man to protect the environment from undesired pollution, which is injurious to all life. For many reasons man is mostly responsible for the pollution of air, water, soil and in turn responsible for global warming, climate change and health hazards, dwindling of forests, water resources and undesirable changes in ecological balance of the biosphere, destruction/dwindling of natural resources. It is the fundamental duty of every citizen (by virtue of constitution) to protect and improve the natural environment including air, forests, lakes, rivers and wildlife. It is in this context, the following government protection Acts came into existence.

1. The Environmental Protections Act, 1986
2. The Air pollution Act, 1981
3. The water (protections and control) Pollution Act, 1974
4. The Indian Forest Act 1927 and Forest (protection) Conservation Act, 1980
5. The Wildlife (Biodiversity) Protection Act, 1972 and
6. The Public Liability Insurance Act, 1991

Man is the highest form of life on the earth, but he is dependent on other forms of life and environment. Man has the ability to modify or destroy an environment or burn a whole forest and cause damage to the ecosystem, yet he is very closely dependent on the nature-environmental system, like atmospheric oxygen for breathing, and animal, plant kingdom for his food.

According to UN Report, at present mankind is persisting with thoughtless and extravagant consumption of natural resources and damaging the natural resources in an unprecedented manner. UNEP (United Nations Environment Programme) outlook-4 report (25 October 2007) says, at the present consumption rate it requires 21.9 hectares per person while earths capacity (on an average) 15.7 hectares per person. As a result of this 116550 square kilometers of forest area being lost across the world each year. 60% of the world's major rivers have been damaged or diverted and fresh fish

population declined by 50% during last 20 year. About 30% amphibians, 23% of mammals and 12% of birds are under threat of extinction due to human activity, while 10% of the world's large rivers are running dry every year before reaching in to sea. The US's consumption of energy increased by 20% over the last two decades. Of the total GHGs (greenhouse gases) increased in atmosphere by human activity, 70% accounts to energy sector. The IPCC further noted that due to global warming there would be glacier retreat in the Himalayas, sea level rise, production of wheat, rice, maize would drop in India and China and more than one billion people may face fresh water shortage by 2020. International Renewable Energy Agency promotes the adaptation of renewable energy worldwide and aims to provide a definite policy advice and facilitates capacity building and technology transfer.

1.2 ENVIRONMENTS IN NATURE

It is common observation plants and animals live under variety of conditions. A wood, a field, a deep ravine or a marshy land all create totally different environments from each other. All they have a direct effect on the organisms under their influence. As said earlier each environment made of many factors. The physical factors include soil condition, temperature, sunlight, water, atmospheric conditions and changes in earth. Equally important are the biological factors or the living surroundings of organisms and non-living surroundings. A plant growth depends on soil, temperature, water, sunlight and atmospheric conditions. The plants in turn create environment for animals. Almost any set of environmental conditions are suitable for certain plants and animals. Because of this we find living organisms on land, under water bodies and mountain tops to mountain valleys and all atmospheric conditions from north pole to south pole.

BIOLOGICAL FACTORS

A plant or animal lives under influence of other living things together with non-living matter. An individual organism is a part of a large society of life, which is bound to the non living surroundings. The earth offers a wide variety of conditions for life (which is biodiversity). The 5 environmental factors are given below.

Plants and animals have varied requirements.

- 1. Soil:** Soil is a basic factor of environment. The main types of soils- clay loam, sandy loam. Soils may be acidic or alkaline.

2. **Temperature:** It controls environment. All organisms withstand the day and night temperatures. Animals and birds face the problems of seasonal temperature changes. During severe winter animals and birds migrate or move to warmer places. During warm summers they seek cool places. Some undergo into hibernations like frog, tortoise etc.
3. **Light:** Solar energy is a critical factor in the environment of living things.
4. **Water:** Offers profound bearing on the environment living things. Deserts, droughts, evergreen trees, tropical forests etc. are all the effects of water or rainfall.
5. **Atmosphere:** All living things require oxygen hence atmosphere is a factor of environment. Plants and animals which live in deep sea and in the soil seek closer surface to water and soil surface for oxygen supply. Topography/land formation/physical features of the earth have great effect on living things. As the earth changes, plants and animals migrate to new favorable places and new species develop in the new environment, that is, as environment changes living things change with it.

Tropism: The automatic response of a plant or any of its parts toward or away from a stimulus is called tropism

Sensitivity: It is the response of protoplasm to its surroundings

Based on responses, tropism is of six types.

1. Chemotropism – response to chemicals (like soil minerals)
2. Geotropism – response to gravity
3. Hydrotropism – response to water
4. Photo-tropism – response to sunlight/light
5. Thermo-tropism – response to heat

1.3 RACIAL DEVELOPMENT THEORIES

Lamarck's theories: The first racial development theory was presented by French biologist Jean Baptiste Lamarck, in 1801. His three theories are:

1. Theory of need - The production of a new organ or part of a plant or animal results from a need.
2. Theory of use and disuse – Organs remains active as long as they are used and they disappear gradually with disuse.
3. Theory of inheritance – All that has been acquired or modified structure of individual during their life is passed on by heredity to the next generation. Lamarck's theory of use and disuse has little scientific basis.

Darwin's Theory of Natural Selection (1859):

Charles Darwin, an English scientist published his origin of Species by Natural selections. Broadly his theory accepted is given below.

The main factors that accounts for the development of new species from common ancestry are:

- (i) Over production of individuals.
- (ii) Struggle for existence,
- (iii) Variation among individuals
- (iv) Survival of the fittest
- (v) Inheritance of favorable characteristics and
- (vi) New forms better adapted to survive, "Naturally selected" as new species.

Scientists say "God is Nature and Nature is God". This bespeaks volumes about environment and climate change.

The life on earth undergoes gradual changes with changes in environment and climate is termed Racial Development. Fossils are foot prints of past ages, preserved remains or mineral replacements of past ages, preserved remains or minerals replacements of living things of previous ages. The racial evidence has been collected through the study of fossils, homologues organs vestigial organs, embryology, geographical distribution experiments in genetics.

1.4 WORLD ENVIRONMENTAL DAY (WED)

Every year on 5 June, world environmental day is observed to create awareness all over the world about environment. The aim of observation of WED is to focus the environmental issues, to empower people for sustainable and equitable development. To encourage the people to look into environmental issues and to act for sustainable development. To advocate participation of all nations for protection of environment, in order to create safety for future generations. The awareness can be created by street processions competitions in schools, planting trees, rainwater harvesting, recycling of water, cleaning up campaign like swatch Bharat etc.

It stimulates worldwide awareness about Environment and increases political attention and action. WED aims to give human face to environmental issues, empower people as active agents of sustainable and equitable development. It Encourages communications to change attitude towards environmental issues. It advocates partnership for all nations to enjoy secure future. The day is observed by street processions, competitions in schools and colleges, Tree planting, recycling and cleaning up campaigns etc.

The earth charter seeks to inspire all people a sense of global interdependence and shared responsibility for the well being of humanity.

1.4.1 ENVIRONMENTAL MAIN ISSUES

Global warming, climate change, deforestation, energy crisis, air, water, soil pollution, waste material management, control oil spills, population control, use of nuclear energy, nuclear hazard protection, preservation of natural resources for future generation.

During last 150 years, all species of life on earth are affected by environmental issues, which are invading and threatening the air, water and soil pollutions. The main issues are given below.

1. Global warming and climate change
2. Deforestation, weakening the lungs of the earth
3. Energy shortage crisis
4. Environmental pollution
5. Harmful toxic wastes/Radioactive waste
6. Oil spills which harms/extinct some marine life. Plastic dumping in lakes and seas will have adverse effect on marine life
7. Depletion of natural resources
8. World population explosion, 74 million people per year. 2010 world population estimated to be 6909×10^6 and it would be 8012×10^6 by 2025
9. *Nuclear Issues*: Nuclear weapons-dangerous to environmental issues
10. Strengthening world greenery or lungs of the earth-Go Green
11. Globally, phytoplankton absorbs as much as CO_2 as tropical rainforest. It is therefore, very important to understand their response to global warming.

1.5 ENVIRONMENTAL PROTECTION ACT

To prevent decline of environment, biodiversity world community decided to protect environment. The UN Conference on environment held in Stockholm (in June 1972), recommended to enact a comprehensive law to take action for environmental protection. As a result Government of India introduced Environmental protection Bill and passed in 1986, and came into force on 19-11-1986 vide and GSR 1198 E, 12-11-1986 (GSR = Gazette Statute Rules). The environmental act aims at the protection and improvement of Environment, prevention of hazards to human beings and other living creatures, plants and property.

According to IPCC (Inter Governmental Panel on Climate Change) Report 2007, global average temperature rose by $[0.74 \pm 0.18]$ °C during 1906-2005. Widespread ice melt caused average sea level rise at the rate 1.8mm per year during 1960-2003 and Arctic sea ice reduced by 2.7% per

decade since 1978. Over the period 1901-2009, the mean annual temperature seen to be increasing trend of $0.56^{\circ}\text{C}/100$ year and increase in mean temperature of the world $+ 0.74^{\circ}\text{C}$, while in India it was recorded a rise of $+ 0.5^{\circ}\text{C}$ during the same period. In the changed state the effects on biodiversity is unimaginable. University Leeds, UK predicted that 15-37% of plant and animal species over the world face extinction by the year 2050.

Note: Geotropism means the response of plants to gravity

Gene: A determiner of heridity, located in a chromosome.

Tropism: It is the involuntary response of an organism to a stimulus

Hydrotropism: It is the response of roots to water

Omnivores Organism: It is one which eats both plant and animal substance.

Predator: Any animal which preys on other animals.

Parasite: An organism which gets its food entirely from another living organism

Phylum: one of the large divisions in the classification of plants.

Protoplasm: The living substance which is the physical basis of all life.

Movement of Energy in Ecosystem

Ecosystem is the totality of organisms in a particular place (or region) and the environment in which they live. The living organisms interact with each other and with environment (in which they live)

Ecosystem may be viewed as energy processing units

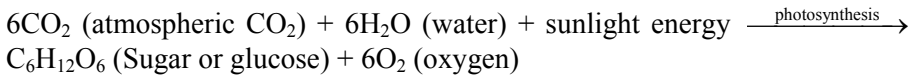
The complex nature of ecosystem definition

1.6 ECOSYSTEMS

Soils, vegetation and climate together form environments/ecosystems, whereas a group of specially adopted plants and animals coexist, each depending on the other for their survival. As long as the ecosystem remains undisturbed the plants and animals remain almost constant. Disturbance imbalance may be disastrous. For example, goats are voracious animals which were responsible for the destruction of original coniferous forest in Mediterranean lands. The present day climax vegetation is actually secondary plant cover.

The sun is the main energy source for all living matter. Green plants and some bacteria derive their energy (food) from the sun through photosynthesis process. This energy is stored in plant tissues and converted into mechanical and heat forms in metabolic activities.

The chemical equation of photosynthesis is given below:



In respiration process, the sugar produced in plants is broken into energy by plant organells. This energy is used by plant for its growth, repair and reproduction. This respiration is a reverse process of photosynthesis . The respiration chemical equation is given below:



1.7 AUTOTROPHS AND HETEROTROPHS

Plants and bacteria which use insolation for the production of their food are called Autotrophs while other life forms which depends on autotrophs for their food (life energy) are called Hetrotrophs. In this biological process the energy flows from sun to plants (autotrophs) then to all heterotrophic organisms (like microbes, animals, human beings). This energy flow is represented as below:

- Sun → Plants or producers (metabolism)
- (a) Consumers → heat energy
- (b) Chemical energy → decompose (Metabolism) → heat energy
- (c) Heat energy (digestion)

Energy produced by mechanical motion is called kinetic energy while that is stored by virtue of its position is called potential energy.

Biological activity of an ecosystem is dynamic and required energy utilization.

All living organisms store potential energy by way of chemical energy of food. Oxidation of food gives out energy which is used to do work (that is chemical energy is transformed into mechanical energy)

Few autotrophs use energy released by oxidation process for the synthesis of organic food.

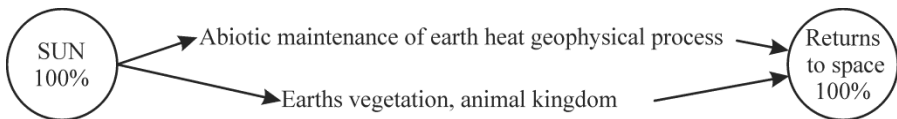


Fig. 1.1 Flow of energy on the earth

Chloroplasts: Only green organs (like leaves) plants are capable of assimilating atmospheric CO₂. The green pigment is called chloroplast (a plastid containing chlorophyll)

Metabolism: Refers to all energy transformations in living matter (that is, the physiological and chemical processes of the body)

1.8 COMPONENTS OF AN ECOSYSTEM

Definition: According to Odum (1983)

Ecosystem has six components, three biotic and three abiotic

The biotic components are:

1. Producers – all autotrophs
2. Macro consumers – animals which eat or ingest other organisms
3. Micro consumers – (Saprobies or decomposers) which include hetrotroths decomposing dead organic matter.

The three abiotic components are:

1. Inorganic substances, like Carbon, Nitrogen, Hydrogen
2. Organic compounds like proteins, carbohydrates, and
3. Climatic factors like rainfall, temperature wind, light etc.

Note: *Ecology*. The specialized term for the environmental biology is ecology [derived from the Greek roots “oikos” meaning “house”]

1.9 ECOLOGY

It is the study of inter relationship between living things and their surroundings (or environment)

Ecological Succession: Plants and animals continually move on earth. Plant population of an area gradually changes. Along with this change animals find new living homes (habitats). This movement of living things is termed Succession. An initial open field gradually turns to meadow, then it will have shrubs, then turns into forest like area and changes the environment and then into dense forest with big stable trees with Climax plants.

Open field → Meadows → Sun loving trees and shrubs → Forest like area → Environmental change → dense forest with tall tress (like maple, beech) that control the area, which are climax plants.

Grasses are climax plants in the Great plains

Climax species may be destroyed by fire, wind or cleared by man. The area is left to the nature. In this area succession starts again and eventually will be taken over by climax plants again.

The changes in the physical environment and sequential changes lead to establishment of stable community. At any location (area) due to changes in physical environment one community replaces by another. This establishes the pattern of ecological succession with the following parameters.

Succession is an orderly process, community changes in certain direction. Changes in the physical environment by community results in succession. Because it is a biological process on a site (location) it leads to stable ecosystem with succession climaxes.

All living organisms are under the constant influence of physical factors of the environment, like soil, temperature, water, light and atmospheric conditions. These factors determine growth of plants and in turn provide an environment for animals. A set of conditions are favourable for development of certain plants and animals. As a consequence living organisms occupy the land, water bodies and atmosphere from North Pole the South Pole, mountain tops to valleys or deep ocean bed.

The species involved and time required for reaching stability, all depend on the physical factors is called biological process.

The physical environment determines succession process. The stages of succession are called serial stages. The final steady state is called Climax (which remains stable).

Successions are of two types-Autotrophic and Heterotrophic succession.

Autotrophic succession is governed by plants (having chlorophyll). This type succession is abundant and starts in inorganic environment.

Heterotrophic succession is governed by early dominance of heterotrophs which flourish in *Organic Environment*

Succession is divided as primary and secondary succession.

Primary succession begins in a sterile area where conditions are not favourable. The first stage is nivation (bare) or exposure to the new surface over which seeds germinate and seedlings establish. This process is called colonization. Arrival of new migrants that support population rise is called aggregation. The first colonized organisms are called pioneers. Hydrarch succession begins in water. Hydrotropism is result of the response of roots to water. Water bodies like ponds, lakes are colonized by phytoplankton's, which consists of microalgae which forms pioneer colonizer. Autotrophs and animals that die in water body adds organic matter. This organic matter is used by bacteria, fungi and release minerals. Thus aquatic body gradually becomes the nutrient rich and support the growth of rooted hydrophytes like Vallisneria, Ceratophyllum. When hydrophytes die, they are decomposed by microorganisms that release nutrients. This results in the decreases of aquatic body and hence decreases the margin of the pond. In this margin Nelumbo, Trapa and such plants grow in mud. Deposition of organic matter and evaporation of water makes nutrient rich pond. There by swampy ecosystem forms. Subsequently it will be gradually taken over by land plants and this further leads to the formation of jungle/deciduous forest. Finally (in long

years) it will be occupied by steady plant community resulting in climax formation.

Pond Ecosystem → Phytoplankton → Rooted aquatic plants → Free-floating and rooted plants → Reeds and sedges → Terrestrial communities → Climax vegetation

1.9.1 TYPES OF ECOSYSTEMS

There are two types of ecosystems. 1. Natural ecosystem and 2. Manmade ecosystem (or man modified ecosystem).

Natural Ecosystems are: Terrestrial and Aquatic. Terrestrial ecosystems are identified by forests, woodlands, savanas and grass lands.

Aquatic Ecosystems are: Fresh water or marine

Man made ecosystems are: Villages, towns, cities Agr-economy system, Aquat-culture and Reservoirs etc.

All ecosystems have the basic structure, function of energy sources primary producers consumers, decomposers with flow of energy and cycling of materials.

Xerosere: In exposed rocks or dry sand some plants grow, which are the habitats of xerach succession. The pioneer plants are Lichens, which disintegrate rocks through chemicals. Very small quantity of soil particles reach the rock or fall into crevices of rock. The crevices become the home for Mosses and Selaginella and aid to soil formation by increasing rock erosion. With the advance of time, grasses, animals and herbaceous plants grow on the soil formed on rocks. Subsequently mixed woody plants and then climax vegetation establishes.

1.10 TYPES OF CLIMAX

According to Braun-Blanquet (1937), there may be climate climax, edaphic climax and biotic climax. Succession may not always be progressive but at times may be regressive. Forest may get degraded into grass land patches. This is regressive succession. A climax community may be established through primary succession on sand dunes or barren area in lava flown area, which may take 1000 years. On an abandoned agricultural land or over degraded forest area secondary succession may take place in about 200 years for developing into a mature forest.

Importance of climax: climax community is stable with (i) greater biological diversity, (ii) larger biomass structure and (iii) balanced (or equatable) energy flow. These three factors improve the physical environment. As a result man gets food, fuel, fodder, medicine etc. with the stable community. This climax community controls climate and balance bio-geochemical cycles.

1.11 FOOD CHAIN

Green plants absorb solar energy, convert into chemical energy through photosynthesis process. This energy is stored in food material through a series of organisms and hence called food chain. Food chain represents a single energy pathway. Energy flow from autotrophs or green plants through consumer organisms in each trophic level is called food chain.

Food chain shows the energy flow process and feeding relation. Also shows interactions between living things in an ecosystem. All green plants of the biological community are known as producers

Herbivores: Animals which feed on producers (green plants) are called herbivores also called primary consumers eg. Deers, rabbits, goats, pigs.

Carnivores: Animals which feed on herbivore animals are called carnivores e.g., Lion, tiger, leopard. They are also called secondary consumers.

Note: Algae: Athallophyte plant containing chlorophyll.

Anabolism: Constructive process of metabolism

Catabolism: The destructive phase of metabolism

Lichen: A thallophyte composed of an alga and fungus living together for their mutual advantages.

Examples:

Food chain on land

Grass → goat → Lion

Grass → Deer → Lion

Green plants → grasshopper → frog → snake → peacock

Plant sap from leaves → plant lice → spider → sparrow → hawk

Food chain in a pond/lake

Microscopic Algae → protozoa → small aquatic insects → large aquatic insects → small fishes → large fishes

Food chain in the oceans

Phytoplankton → zooplankton → small fishes → large fishes → still larger fishes → crocodile

Type of food chains: Broadly can be differentiated as: (i) Grass land and (ii) pond types of ecosystems cattle and rodents graze grass land while zooplankton consume producers of a pond.

1.12 TROPHIC LEVELS

Through food, energy uses move one organism to another. All green plants (energy produces) categorised as trophic level one, while herbivores in trophic level two. Animals that feed on herbivores are in trophic level three. Animals that feed on the trophic level 3 are in trophic level 4 and that feed on the trophic level 4 are in trophic level 5.

Each food chain has at least three food levels (also called trophic levels) namely producer, herbivore and carnivore levels. It is worth nothing that if the herbivore is large in size then the food chain is shorter. If the herbivores are smaller in size then the food chains becomes longer.

Transfer of energy: In a food chain each organism dissipates a part of energy carrying out different processes of life implying transfer of energy one organism to the next is not 100%.

1.13 FOOD WEBS

The close knit relationship of living organisms and the threads is that constitute the web of spider. Because of this the biosphere is described as the web of life wherein each organism plays specific role:

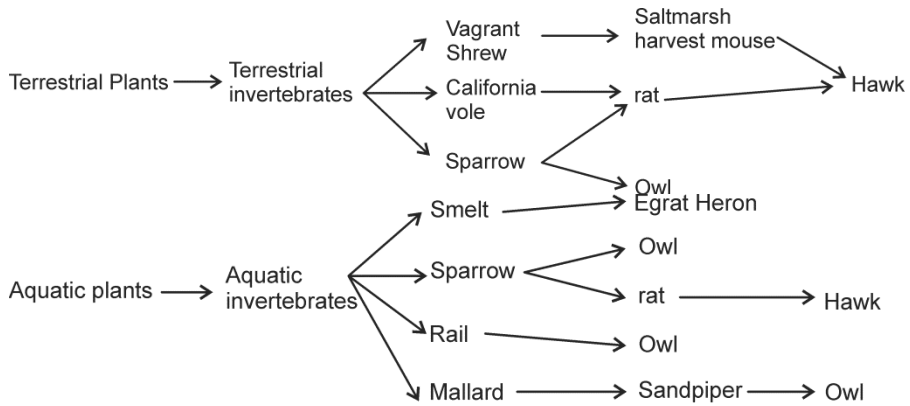
Def: complex food chain in which one population feeds on a number of other populations is termed food web.

Food webs are of two types: (i) Grazing and (ii) Detritus (i.e., wornout matter).

In Grazing food web, energy and minerals move from green plants to herbivores and then to carnivores. Phytoplankton forms the primary Grazing food web in aquatic life. Zoo plankton (small floating animals) in turn are food for small fish and filter feeders.

Producers and consumers are part of the grazing food chain, while scavengers and decomposers are of detritus food chain. Producers are green plants. Primary consumers are herbivores, secondary and a tertiary consumers consists of carnivores (like lions, human beings, snakes). Scavengers like vultures, crabs eat the remains of other organisms. Micro decomposers are (mainly) earthworms, insect larva and micro decomposers are bacteria and fungi.

Food webs



The food chains and food webs from a critical (delicate) balance in nature.

1.14 ECOLOGICAL PYRAMIDS

In nature, animals at the base of food chain are found relatively plenty and at the end relatively few in number. There is a gradual decrease between two extremes. This is called a pyramid of number and is observed in all types of ecosystems.

Ecological pyramids are constructed and quantified based on feeding relationships and energy transfer through biotic component of ecosystem. This type representation enables us to compare the ecosystem and their changes (variation).

Pyramid number: The pyramid that deals with the relationship between the number of primary producers and consumers of different order is pyramid number. In pyramids base is always shown by primary producers. Subsequent structures stand on this base with the number of consumers at successive levels. On the top lie the number of carnivores in the ecosystem.

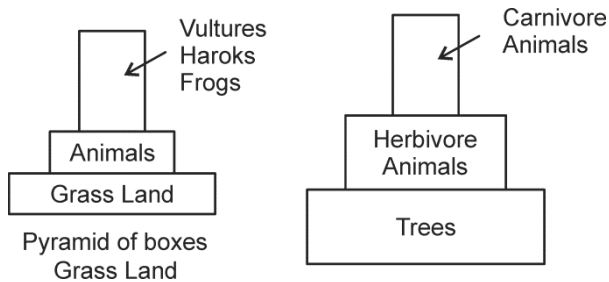
Consumers are of three types-primary, secondary and tertiary. Primary consumers are herbivores while secondary consumers are carnivore and tertiary consumers are also carnivores.

Depending on the ecosystem the shape of the pyramid changes (one ecosystem to another ecosystem). In aquatic and herbaceous communities the size of autotrophs are small but their density per unit area is large. In forest ecosystem the size of producers is large but their population density (need not be large) is comparatively small. Both in grass land and aquatic ecosystem autotrophs are large (in number) but their size is small. The

pyramid structure is upright. In parasite food web inverted pyramid (base small & stop large) is observed.

Pyramid Biomass: In pyramid biomass the base is the weight of primary producers and this pyramid is upright. The biomass of one tree is very large and the mass of birds feeding on it is very very small. Similarly the biomass of a very large number of parasites resting on or in the body of birds is far less compared to the bird. Hence the pyramid of biomass is upright, but in case of number it is converted. For example, a tree may require 5-10 years to produce first seed, where as a algae type bacteria (diatom) may take few hours to produce a large number. A diatom may reproduce billions and billions in 5-10 years. In all this biomass were to survive which would be heavier than a tree.

Pyramid of energy: This represents the total quantity of energy utilised by different trophic level organisms of an ecosystem per unit area over a period of time. Taking time factor into consideration the pyramid of energy is always upright. The quantity of solar energy trapped by green plants over a period of one year is highest as compared to other organisms of other trophic levels. Because of this the base of this pyramid is broad. In aquatic ecosystem the populations of phytoplankton quickly complete their life cycle and begin new generation of crops.



Terrestrial Ecosystem: The effect of climate on rock material and the available flora fauna results in the development of various types of Ecosystems. The major terrestrial ecosystems are forests grasslands, deserts etc.

Note: Biomes: Large recognisable communities in different parts of the world are termed biomes. Biomes are biological expressions of the interactions of organisms with physical factors in different regions of the world. Similar environmental conditions create similar biomes in different parts of the world.

Biomass: Any organic matter which is renewable or weight of living organism

Biota: The flora and fauna of a locality (or region)

Productivity: Formation of biomass by the use of solar energy is called productivity.

Biodegradable: Substances that breakdown naturally are called biodegradable.

QUESTIONS

1. What according to constitution of India ride Article 51- A(g) shall be one of the fundamental duty of every citizen of India about environment?
2. What is meant by sustainable development and what is the aims of Johannesburg 2002 UN commitment about environment.
3. Define environment and state the physical factors of environment.
4. What is the main composition of all living organisms and basic elements of water air-shells of the earth?
5. Write the annual production of plant kingdom, and the supply of an average size tree. Why the plant kingdom is called the lungs of the earth?
6. Why is called man in responsible for the global warming and climate change?
7. Name the Governments/Acts that are enacted to protect environment, air pollution, water pollution, conservation of forests and wildlife protection.
8. What is the outlook 4 of UNEP report?
9. Write briefly about environments in nature, and environment factors.
10. What is tropism? Name the sixty types of tropism.
11. Write briefly the theories of Racial development.
12. What is the significance of world environmental day?
13. What are the main environmental issues?
14. Write the comprehensive law for environmental protection.
15. Write briefly about ecosystems.
16. Write briefly about ecological succession and types.
17. Write briefly about types of climax.

18. What is food chain? Explain the terms Herbivores carnivores Anabolism and catabolism
19. Write briefly about Trophic levels and food webs.
20. Write briefly about ecological pyramids.