

Introduction to Environment

Unit

1

Unit 1

What is Environment?

Introduction

We live on earth in different types of surroundings. This surrounding is our environment. We eat, breathe, clothe ourselves, reproduce and then die. The next generation comes and the cycle goes on; and the human race flourishes on earth. The physical environment on the earth provides favourable conditions for the existence and growth of different life forms, including man. These living beings constitute the biological environment. Both the physical and biological environments are in a close interaction with each other and form a stable self-perpetuating system. In prehistoric days man lived in harmony with nature but in the course of his evolution man has developed a new type of environment, the man-made environment.

Man is a social animal; the socio-cultural environment also plays an important role in his life. In this unit you will study these three types of environments i.e. natural, man-made and social environment. The environment is constantly changing and this affects life on earth; some of these effects can be lasting and irreversible. So we must realise that we should be concerned about environment.

What is Environment?

Each and every living organism has specific surroundings or medium with which it continuously interacts, and to which it is fully adapted. This surrounding is the 'natural environment'. The word 'natural environment' brings to mind broad aspects of landscape, such as soil, water, desert or mountains which can be more exactly described in terms of biological influences. Thus, environment is the sum total of living and non-living components; influences and events surrounding an organism. Living components are called biotic components while non-livings are called abiotic components.

No organism can live alone without interacting with other organisms so each has other organisms as a necessary part of its environment. We know that all animals are directly or indirectly dependent upon green plants. However, plants also depend on animals for the few things such as pollination of flowers and dispersal of seeds or fruits:

Let us try to understand the concept of environment with some examples. Figure 1.1 shows a pond. What would be the components of its environment? The abiotic factors in the pond's environments are light, temperature and water in which nutrients; oxygen, other

gases and organic matter are dissolved. The biotic components include microscopic as well as larger plants and animals. The plants are of different kinds such as phytoplankton, partly submerged plants and plants growing around the edge of the pond. The animals consist of zooplankton, bacteria, insects, worms, molluscs, tadpoles, frogs, ducks and several kinds of fish. The characteristic features of the pond will also depend upon such abiotic features as the intensity and amount of sunlight, altitude, temperature, depth of water and nature of the underlying rocks etc.

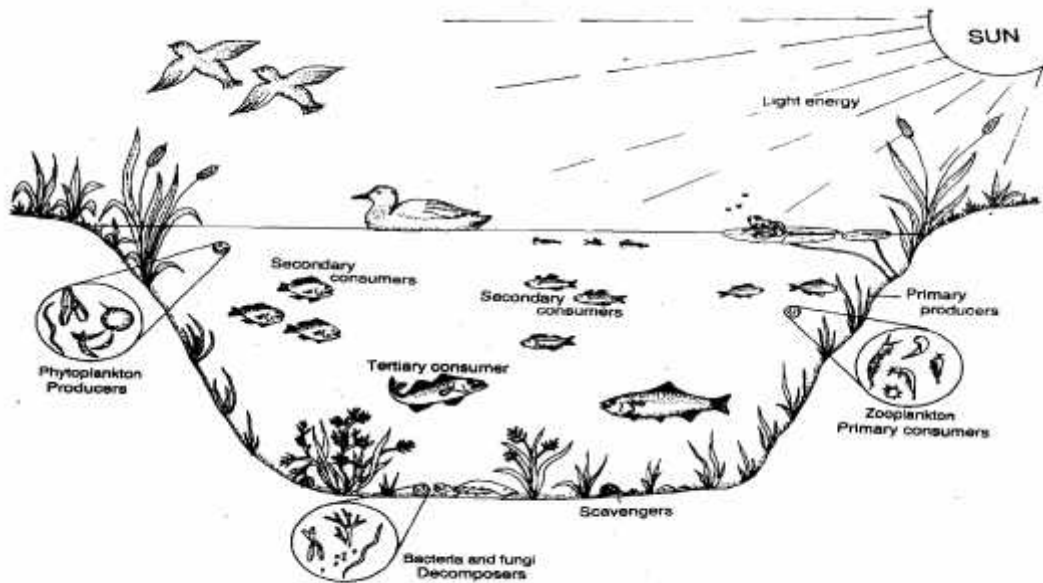


Fig. 1.1: The pond ecosystem.

Now we consider another example, of fish in this pond. The living and non-living constituents in the pond would make the environment of the fish. We can call it the external environment. There is another environment within the body of fish, its internal environment. The body surface acts as an exchange barrier between the external and the internal environment. The internal environment is relatively stable as compared to the external environment. However, it is not absolutely constant. Illness, injury or environmental stress can upset it. But when the cause for the upset is removed, internal environment comes back to its natural condition.

Natural Environment and its Components

Environment includes a number of components. For convenience we have divided them into two categories: abiotic and biotic.

Environmental Factors

Abiotic

Energy
Radiation
Temperature and heat flow

Biotic

Microbes
Plants
Animals

Water	(including human beings)
Atmospheric gases and wind	
Fire	
Gravity	
Topography	
Geological Substratum	
Soil	

Living beings normally cannot exist more than a few kilometers below the surface of the earth, or more than a few kilometers above it. Life occupies an incredibly thin 'skin' at earth's surface. This is known as the biosphere. The biosphere includes four major environmental categories or habitats-marine, estuarine, fresh water and terrestrial.

All the four habitats have sub-types, which have a typical set of physical and biological features and form different ecosystems. Thus, ecosystem is a natural unit of biosphere which is composed of abiotic and biotic components whose interactions result in a stable self-perpetuating system.

The Eco System

What is an Ecosystem?

A species or an organism can never live alone. They are always influencing each other and organising themselves into communities, besides they have functional relationship with their external environment. This structural and functional system of communities and their environment is called ecosystem. The word ecosystem was coined by Tansley in 1935. The prefix 'eco' means environment.

The central theme of ecosystem concept is that at any place where an organism lives, there is a continuous interaction between the living and the non-living components, i.e., between plants, animals and their environment. They continuously produce and exchange materials. This means, that there are mechanisms for continuous absorption of materials by organisms for the purpose of production of organic materials and their conversion back into the inorganic form, much of which is then released back into the environment.

The interaction between living and non-living components of an ecosystem involve; input, transfer, storage and output of energy and essential materials through the system. Each of these processes is energy-dependent. As a result of these complex interactions, the ecosystem has to adjust to these changes and attains a state of equilibrium.

An ecosystem, therefore, is a system that is self-regulatory based on feed-back information about the population, and the limiting factors which control the living and non-living components.

Before we explain the functioning of the components of the ecosystems let us first talk about a larger unit of natural landscape biosphere. "

Biosphere

Biosphere is defined as that part of the earth and atmosphere in which many smaller ecosystems exist and operate. Three main subdivisions of the biosphere are lithosphere, (solid matter); hydrosphere (liquid matter), and atmosphere or the gaseous envelope of the earth which extends up to a height of 22.5 km. Figure 3.2, shows the idealised scheme of biosphere in relation to hydrosphere, atmosphere and lithosphere. The area of contact and interaction between these components is really important for life, for it is here that the entire life is confined and the basic processes of life like photosynthesis and respiration occur.

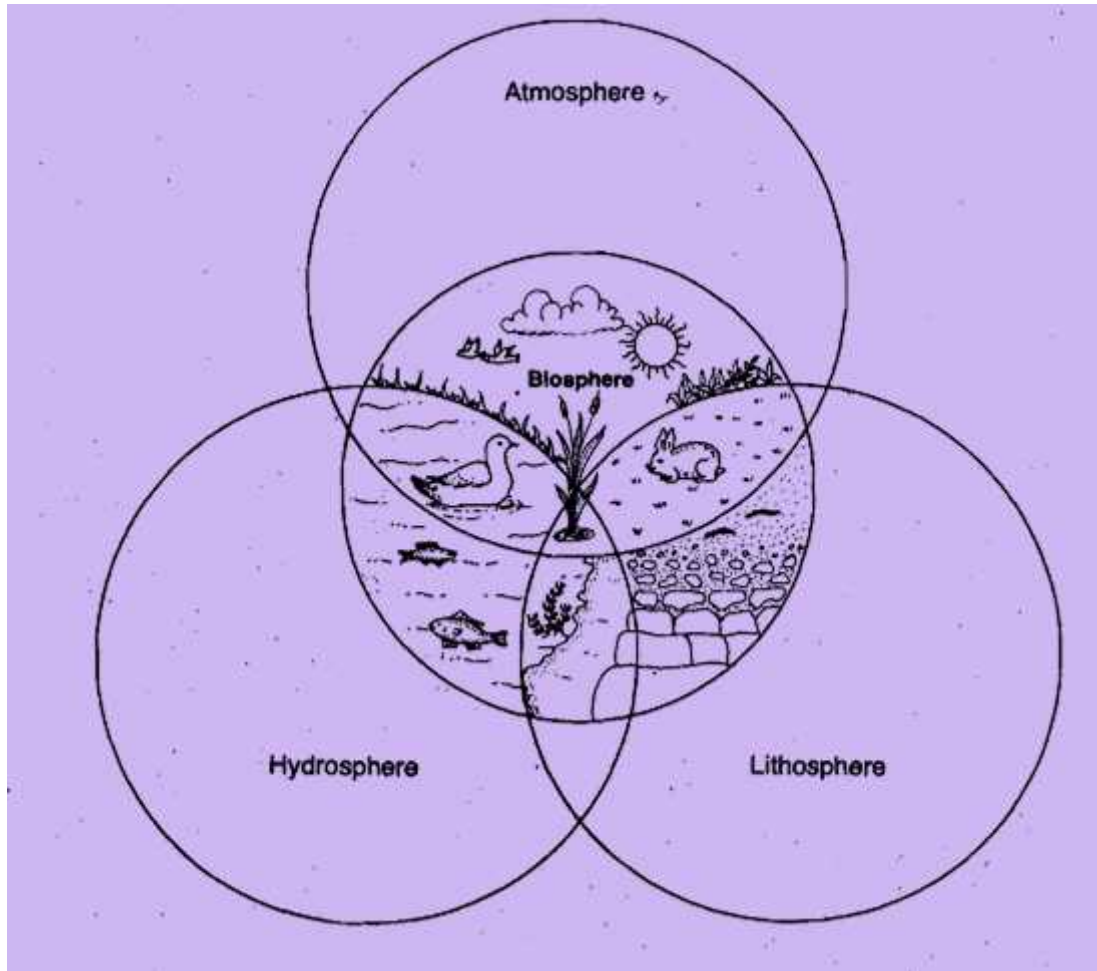


Fig: 3.2 idealised scheme of the biosphere

Living organisms are, mostly, confined to the parts of biosphere that receive solar radiation during the day. As stated above, this includes atmosphere; the surface of land, the few metres of soil and the upper layers of water of oceans, lakes and rivers.

a) Atmosphere

Atmosphere is of much significance to life as all the components of air (except inert ones) serve as metabolites, and each chemical element climates through a cycle maintaining a perpetual supply of metabolites. It is at this stage that the role of organisms, and significance of atmosphere to life emerge on the interface of the biospheric subdivisions.

The green plants incorporate a variety of inorganic elements and compounds. For example, during the process of converting solar energy into chemical energy, atmospheric carbon dioxide enters the living world as the basic constituent of all organic compounds. Carbon dioxide along with water is used by all plants in their photosynthetic process to produce organic substances such as, glucose a vital molecule in living things, and oxygen.

b) Hydrosphere

You know that water is the most important component of protoplasm; hence it is essential for life in all living organisms. In metabolism, it is the only source of hydrogen and one of the several sources of oxygen.

The earth is sometimes called the watery planet as this is the only planet in the solar system which has an abundant supply of water. Oceans form 71 per cent of the total surface area of the earth. Water evaporates with the help of solar energy and moves into the atmosphere. Water vapour after gaining higher altitude cools down and condenses to form clouds, which precipitate as rain or snow and thereby, return to the parent water system, the hydrosphere.

Water is used as a raw material for various metabolic processes. The living organisms draw it mainly from the hydrosphere. During the process of metabolism, water consumed by organisms is partly excreted back into the environment and a portion used for building the organisms is returned to the environment after their death and decay.

c) Lithosphere

The other subdivision of the biosphere is the lithosphere which helps in the metabolic process in two ways. One, it is the only source of most of the minerals for organisms belonging to either terrestrial or aquatic conditions, and two, it forms the soil, required mainly by terrestrial plants.

Components of Ecosystem

The biological or biotic components of an ecosystem include:

- i) Organisms, basically green plants, certain bacteria and algae that can synthesise their own food in the presence of sunlight. These are the autotrophs or producers.
- ii) All other organisms that do not make their own food but depend on other organisms to obtain their energy for survival. These are called heterotrophs or consumers.

Among consumers some animals such as goat, cow, deer, rabbit and insects which eat green plants are called primary consumers or herbivores. Organisms which eat herbivore, like a frog that eats grasshoppers are called secondary consumers. Organisms which eat these secondary consumers are called tertiary consumers. While the primary consumers are herbivores, the secondary and tertiary consumers are carnivores. Animals like lions and vultures which are not killed or eaten by other animals are top carnivores.

Amongst the producers also there is division. Only the green plants and some special types of bacteria which can trap solar energy and produce food are called primary producers, the heterotrophs which are food for other animals become secondary producers.

Consequently an ecosystem is considered as a basic unit, where complex natural community obtain their food from plants through one, two, three or four steps and accordingly these steps are known as the first, second, third and fourth trophic levels or food levels such as :

- green plants (producers) ; trophic level I
- herbivores (primary consumers) ; trophic level II
- carnivores (secondary consumers) ; trophic level III
- top carnivores (tertiary consumers) ; trophic level IV

These are shown in **Figure 3.3**

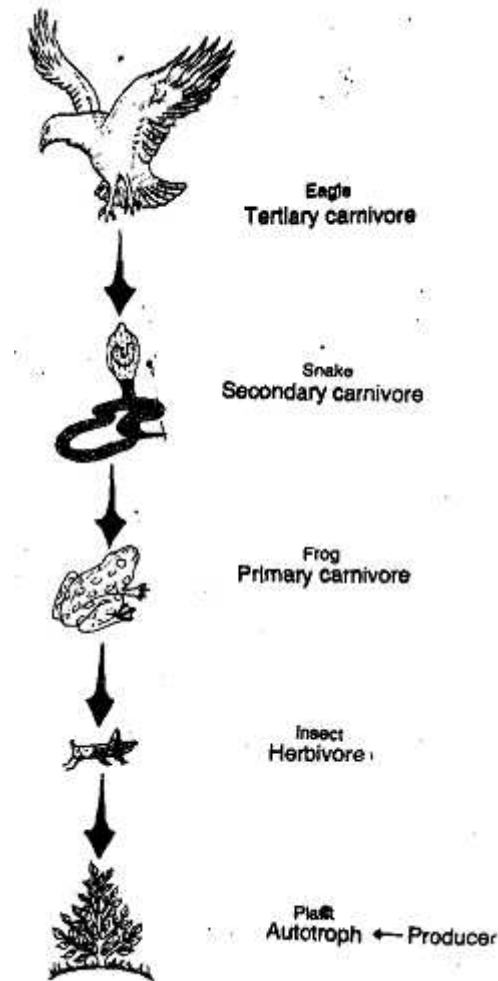


Fig. 3.3: Trophic levels in an ecosystem

Both the consumers and producers complete their life cycles and new generations of ecosystem population develop while the old ones die. You must be wondering what happens to the dead. There is a continuous breaking up or decomposition of the dead organic matter everywhere in the ecosystem. There is a continuous cycling of materials. Certain fungi and bacteria which are responsible for the decomposition are called decomposers or reducers. The role of decomposers is very special and important. Certain decomposers are also called scavengers. Water, carbon dioxide, phosphates and a number

of organic compounds are largely the by-products of organism activity or death of organisms.

The other important components of the ecosystem are abiotic or nonliving components. These are basically inorganic elements and compounds, such as carbon dioxide and water, nitrogen, phosphates, sulphates etc., and a number of organic compounds largely the byproducts of organism activity or death. Other important abiotic components of the ecosystem are the physical factors including temperature, moisture, solar radiation, etc. It is in this abiotic background that biotic organisms i.e. plants, animals and microbes interact.

Functional Components of an Ecosystem

Coming to the functional aspect of an ecosystem, we may study it in terms of the following:

- energy flow,
- food chain,
- diversity pattern in time and space,
- nutrient or biogeochemical cycles,
- development and evolution.
- control or cybernetics.

With the help of the following flow chart, we can interpret the functional aspect of an ecosystem or the interactions between various components which involve the flow of energy and cycling of materials (**Fig. 3.3**).

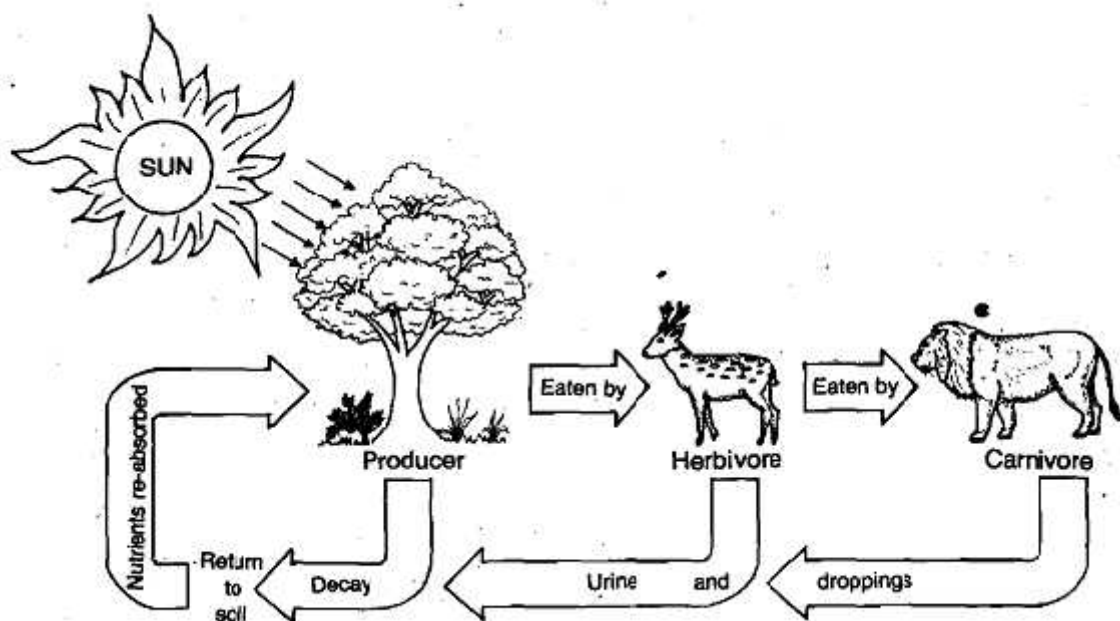


Fig: 3.4 Natural balanced ecosystem

Implicit in the system, such as autotroph → heterotroph, producer → consumer, or producer → herbivore → carnivore relationship, is the direction of energy movement through the ecosystem. In the process, solar energy is

converted into chemical energy through photosynthesis by plants, which also incorporate into their protoplasm a number of inorganic elements and compounds. These green plants are grazed subsequently by heterotrophs. This means that not only the chemical energy in the form of carbohydrates, fats, and proteins is transferred into herbivores but a host of other nutrients as well. This process continues up to the decomposer level through the carnivores. Another feature of the process is that the energy trapped by green plants when transferred from one food level or trophic level to another also depicts energy losses at each transfer along the chain. The following diagram depicts the energy transfers and energy losses in an ecosystem (Fig. 3.5).

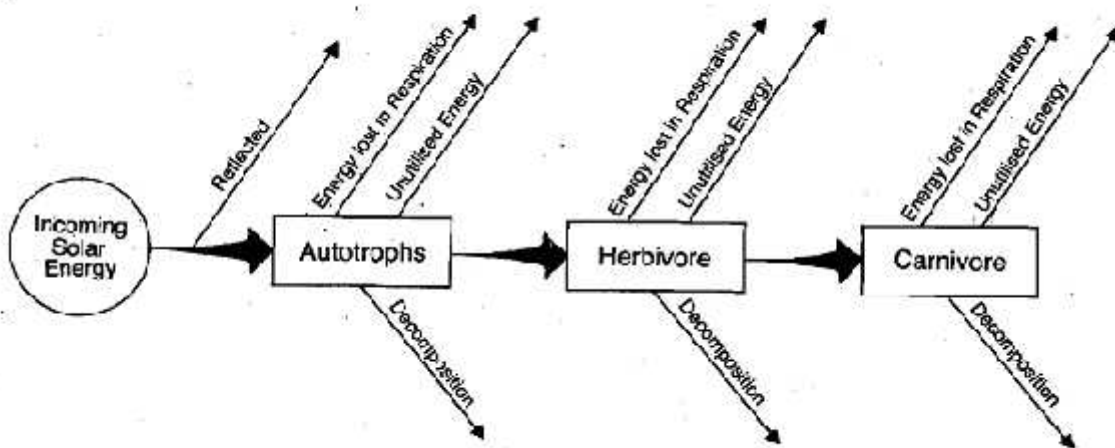


Fig 3.5: flow of energy in ecosystem

From the above diagram, we can conclude the following:

- energy movement is unidirectional unlike the nutrients/materials in an ecosystem, that is, the initial energy trapped by an autotroph does not revert back to solar input,
- energy that passes from herbivore to carnivore does not pass back to herbivore from carnivore. As a consequence of this unidirectional and continuous energy flow, the ecosystem maintains its entity and prevents collapse of the system.

The three living components, i.e. producers, consumers, and microconsumers (decomposers) form the three functional kingdoms of nature since they are based on the type of nutrition and the energy sources they use.

Thus, for a balanced condition, an ecosystem must have self sufficient and self-regulating structural systems. So far as, the abiotic and biotic components are concerned, they invariably indicate a natural tendency to maintain the functional balance within a certain range of environmental fluctuation. In all ecosystems, there is a self-regulatory mechanism or control to check and balance the system.

Food Chain and Food Web

You have learnt that energy flow in an ecosystem is a one way process. We can identify the sequence of organisms through which the energy flows and this sequence is known as food chain. For example, plants are eaten by insects, which are eaten by frogs; these frogs are eaten by fish, which are eaten by human beings. In this food chain, there are five trophic or feeding levels. Several factors are important in determining an animal's place in a food chain. Each species occupies a specific place and has special adaptations that make it fit for that place.

Flow of energy in ecosystems, from sunlight through photosynthesis in autotrophic producers, to the tissues of herbivores, the primary consumers, to the tissue of carnivores, the secondary consumers, determines the number and biomass of organisms at each level in the ecosystem. In addition no predator is completely efficient at capturing its prey; some energy is lost in the hunt.

Some animals eat only one kind of food and therefore, are members of a single food chain. Other animals eat many different kinds of food, so they are not only members of different food chains but also may occupy different positions in different food chains thus ensuring the survival of their species. An animal may be a primary consumer in one chain, eating plants but a secondary or tertiary consumer in other chains, eating herbivorous animals or other carnivores.

Humans are at the end of a number of food chains. For example, a man might eat a big fish, which in turn ate little fishes, which ate small invertebrates, which ate algae. The ultimate size of the population of any animal, is limited by the number of links in the food chain, the efficiency of energy transfer at each step in the chain, and ultimately by the amount of light energy falling on the earth in that region.

Food Web

A food chain represents only one part of the energy flow through an ecosystem and our ecosystem may consist of several interrelated food chains. However, the term food chain implies a simple, isolated relationship, which seldom occurs in ecosystems. More typically, the same food resource is part of more than one chain, especially when that resource is at one of the lower trophic levels. Thus there are interconnected networks of feeding relationships that take the form of food webs (Fig.3.6)

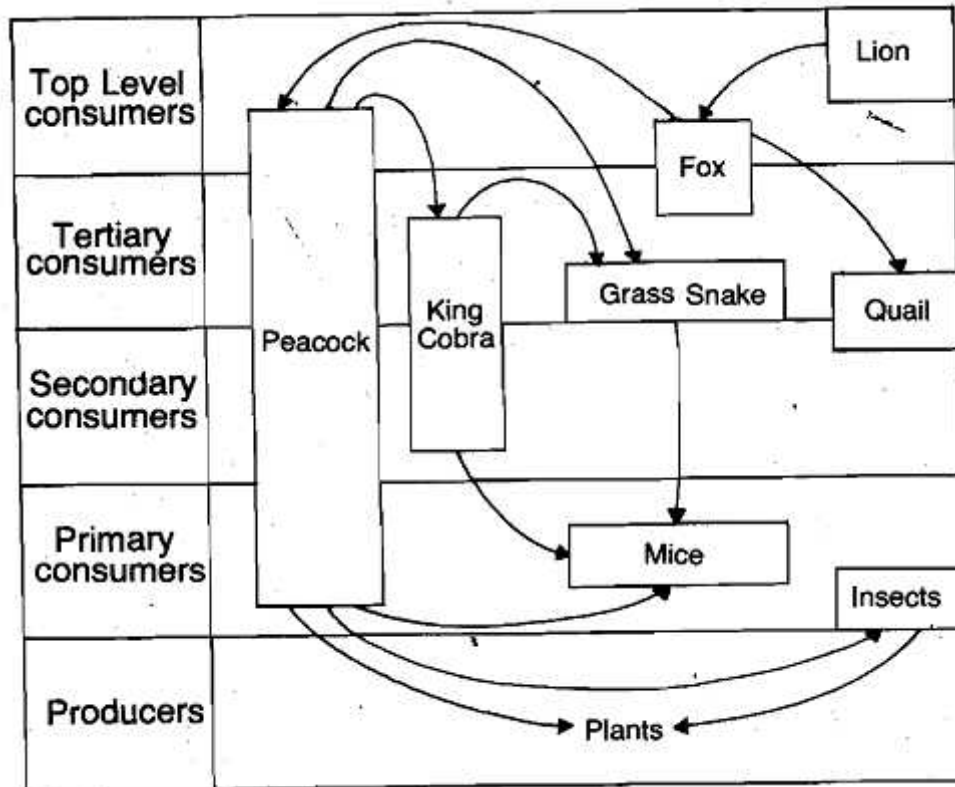


Fig: 3.6

Man-made Environment

So far we have discussed only about the natural environment but there are several components of environment which are created by man. Thus, environment is a totality of natural plus man made environment, the latter including crop fields, cities, industrial space etc. These are the places which are artificially made by man by planned manipulation. To understand the artificial nature of this environment we can take an example of man in a city.

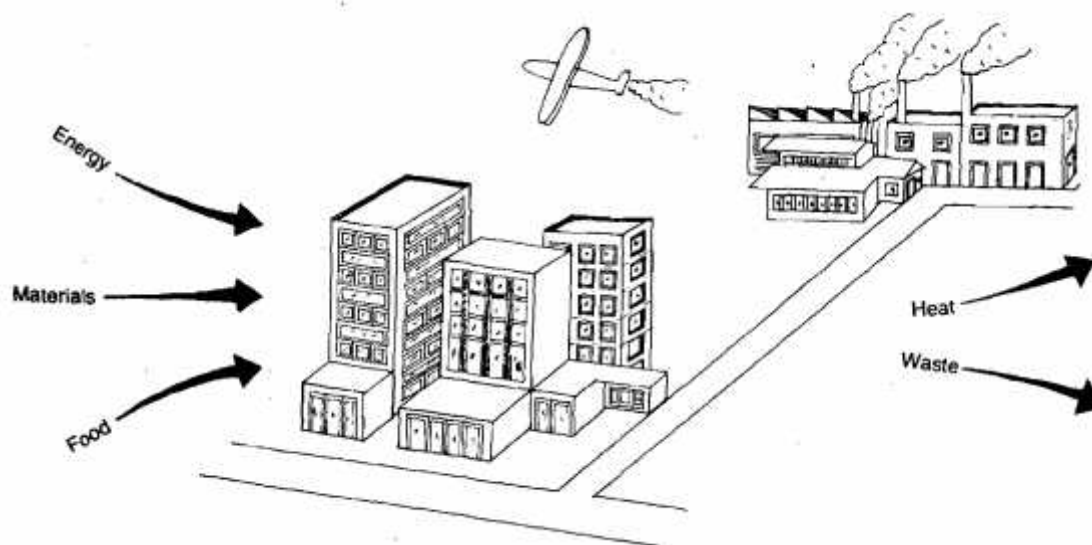


Fig:3.7 manmade environment

The city environment is created by man himself. One of the most important components of life, i.e., water is not taken from streams directly. It is filtered and purified and then used for drinking and other municipal purposes. The metabolic wastes and garbage are not disposed off locally but are carried for treatment or for dumping to a remote place, away from the city. Food for the people in cities often comes from rural areas.

City atmosphere is generally more polluted than that of the rural areas. Factories, vehicles and power plants contribute to pollution of the atmosphere. Residences of city people are made up of bricks and cement, not of mud with thatched roof. So, resources are continuously drawn from rural area for the buildings. The modes of transport are cars, buses, trains, etc. which consume large amounts of energy and pollute the atmosphere. Man has manipulated the environment in a way that suits his convenience and luxury.

Man-made environment results in consumption of excessive amount of materials and energy, necessitating care, supervision and management, and often interferes with the natural environment. Man-made environment of developed countries has changed very much because an average man in developed countries has far more facilities than even the rich people in developing or underdeveloped countries. Let us look at some of these transformations.

Residential

Human settlement is essentially a total concept which is applicable to a city, town or village. Each has a basic organisation with its own social, economic and cultural aspects. The basic requirements include housing, water and sanitation, transport, communication, food, energy, education and health. Shelter is one of the most important needs, with potable water and sanitation coming next.

In olden days, most human settlements used to be along river banks which provided some basic facilities. Economy was agrarian and people mostly lived in rural areas. With the growth of trade and commerce, cities came into being. As population started growing, people started migrating towards towns and cities.

Population growth and migration to the cities has given rise to numerous problems. The atmosphere is polluted by excessive traffic, factories, mills and domestic smoke.

Work Place Including Agricultural Fields

In earlier days it was all natural environment and man was a passive participant in the natural processes. But the growth of agriculture and industry has changed everything -

buildings, roads, railways, water-supply lines, cables for telecommunications, sewers, and several other, kinds of infrastructure which had to be provided has changed the environment. Living condition in developed countries may have improved, but these are based on a high level of energy consumption and exceedingly expensive system of transportation.

In developing countries, most of the people are denied the essential urban amenities and services. Urban amenities are only for the upper rich strata who can afford them at the expense of others. But factors such as noise, pollution and physical stress are borne by all the people living in an area. It is well known that if there is an undesirable change in physical, chemical or biological properties of air, land or water, it will always result in harmful effects.

Social Environment

You already know that man lives in an environment where both abiotic and biotic factors affect him. He learns to adapt himself to these in several ways. There is also another kind of environment which plays an important role in man's living conditions, this is the social environment.

Social environment includes cultural norm and values. Political, economic and religious institutions constitute an important part of the social milieu and often decide how the environmental resources will be utilised by people and for whose benefit these will be utilised. As such, these factors put constraints on resource utilisation.

The social environment can be understood in terms of broad structural arrangements of the society. Let us first be clear about what we mean by social structure. Social structure has been described as the network of social institutions. It is a complex of various groups and institutions which constitute the society

The existence of human society requires certain arrangements which can be delineated in terms of patterned relationships between groups and institutions. The minimum requirements seem to be:

- i. An economic system dealing with the production and distribution of goods.
- ii. A system of communication which includes developing a language and also technology so that information can flow from one part to other. Language changes according to one's culture. To illustrate new scientific knowledge new technical language has had to be evolved to explain various concepts in science and technology. Various media, print and electronic are all a part of communication technology.

- iii. Arrangements including family and education; or raising a well balanced family including the education of children so that every individual is able to contribute towards society.
- iv. A system of authority and power. This is done through political institutions, which are necessary for the attainment of public goals.
- v. A system of ritual, serving to maintain or to increase social cohesion and to give social recognition to significant personal events such as birth, courtship, marriage, and death.

The major institutions and groups of the society are concerned with such basic requirements; together they constitute social environment. Let us talk about some of them in a little more detail.

Family

Family is one of the basic institutions of social organisation. In the wide context of the socio-cultural environment, it performs various functions including reproduction of humans, socialisation of children, transferring of cultural traditions from one generation to another, and so on. Functions of the family are varied in nature, based on the norms, values, beliefs and morals of the society.

Groups of families live together and form communities. These communities could be classified on the basis of their occupation, religious faith, country, etc., and together they form the society within a geographical boundary. Thus, society can be called a group of interacting people who live in a specific geographical area, who are organised in a cooperative manner and who share a common culture.

Culture

So, the question arises "What is culture?" Culture is the man-made part of the environment. It determines social environment and social action. Culture guides a person to select a particular set of behaviour that is permitted to him by his biological heritage. According to Edward Tylor, a British anthropologist, "culture is that complex whole which includes knowledge, beliefs, arts, morals, law, customs and any other capabilities and habits acquired by man as a member of society". The cultural environment cannot remain unaffected by its social norms, economics, political and religious institutions.

Economy is an important factor which determines how resources are acquired and used. For example, surface mining of coal is preferred to underground mining in many parts of the

world because it is much cheaper though it is environmentally much more destructive, especially as it adversely affects wildlife habitat. Thus economic activity is directly related to one's survival and is in turn affected by the total cultural environment.

The legal system helps to regulate the social mores of society. It defines the rights and privileges of the citizens. It can play an important role in conserving the natural habitat. For example, Conservation Law can affect how much habitat is destroyed, how much hunting and poaching occurs, and which species will or will not be hunted. Similarly appropriate legislation can ensure proper land use by preventing undue urbanisation of agricultural land by fixing a suitable proportion of built-up area to green-belts which function as lungs of the large cities. Legislative measures can also ensure a judicious and equitable distribution of land.