UNIT-1 What is Environment

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ What an environment is
- ✓ Identify the components of eco-system
- ✓ Describe the terms sustainability and sustainable development.

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.

Explanation

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.

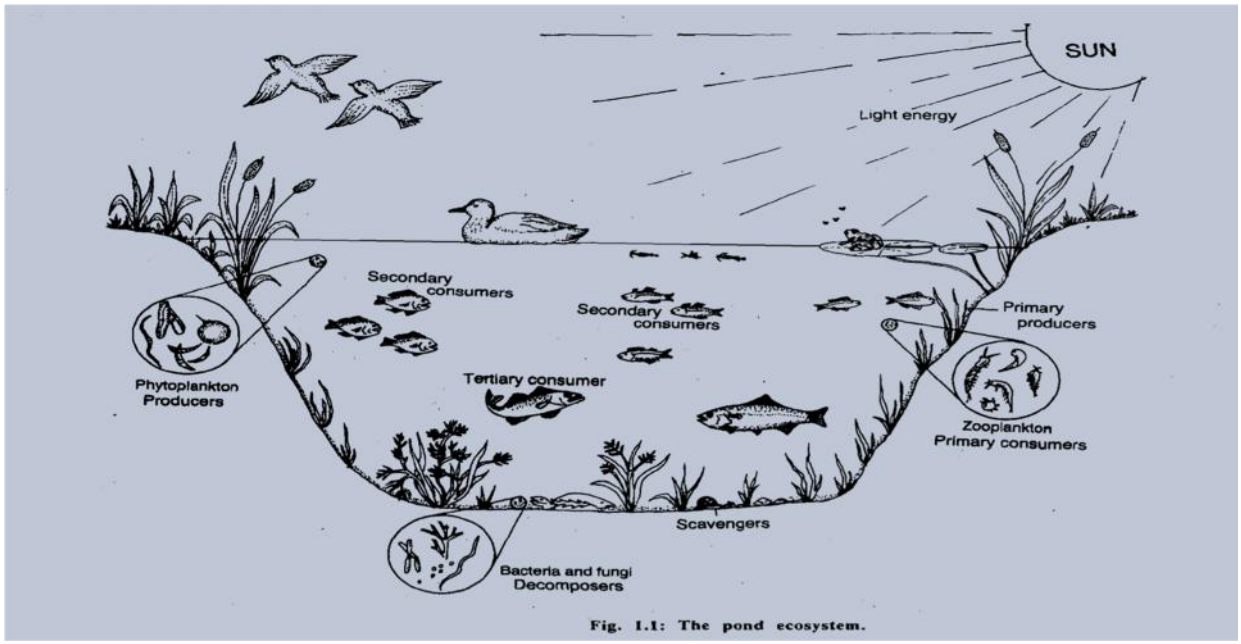

Fig. 1.1: The pond ecosystem.

Fig. 1.1

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	**Biotic**
Energy	Microbes
Radiation	Plants
Temperature and heat flow	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, estuerine, 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 1.2, 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.

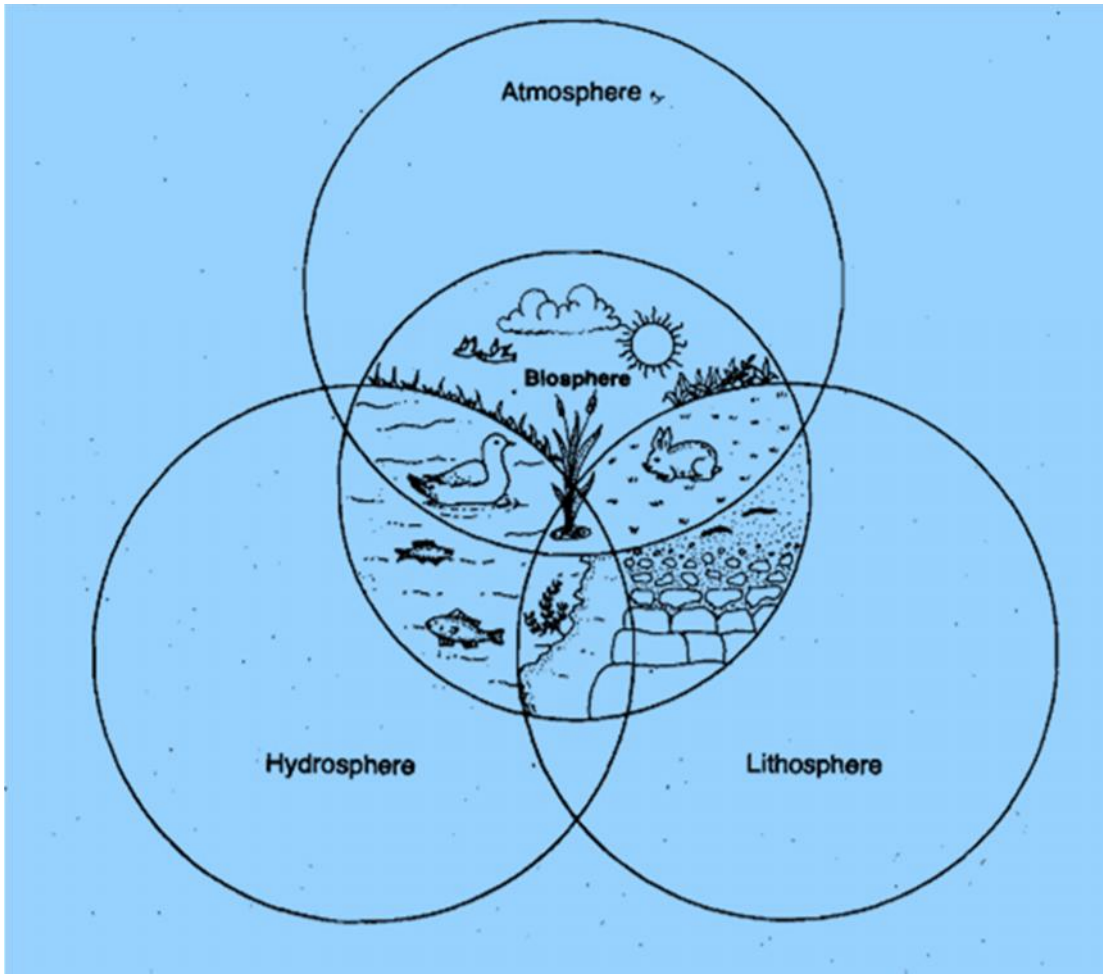

Fig: 1.2 idealised scheme of the biosphere

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.

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.

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.

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

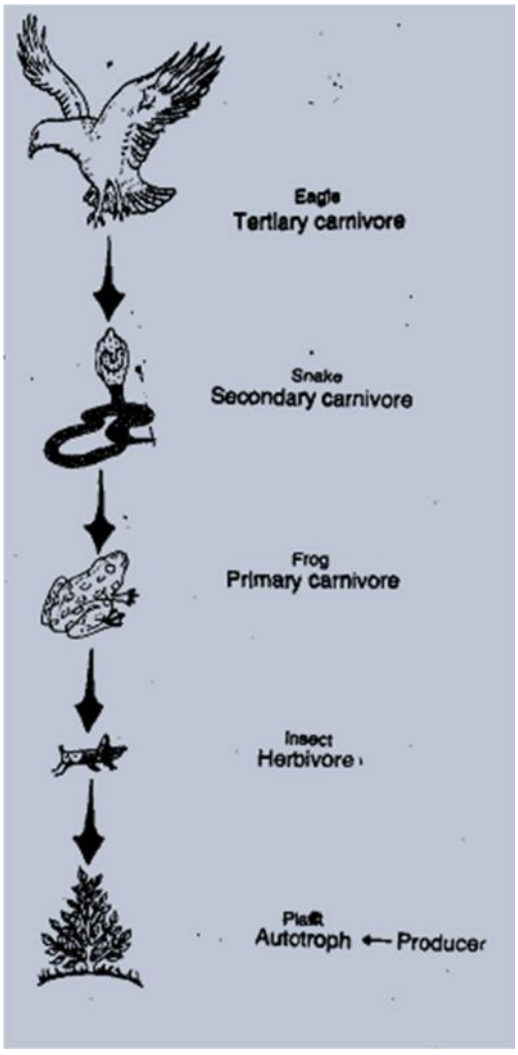

Fig: 1.3: Trophic levels in an ecosystem

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: 1.3**).

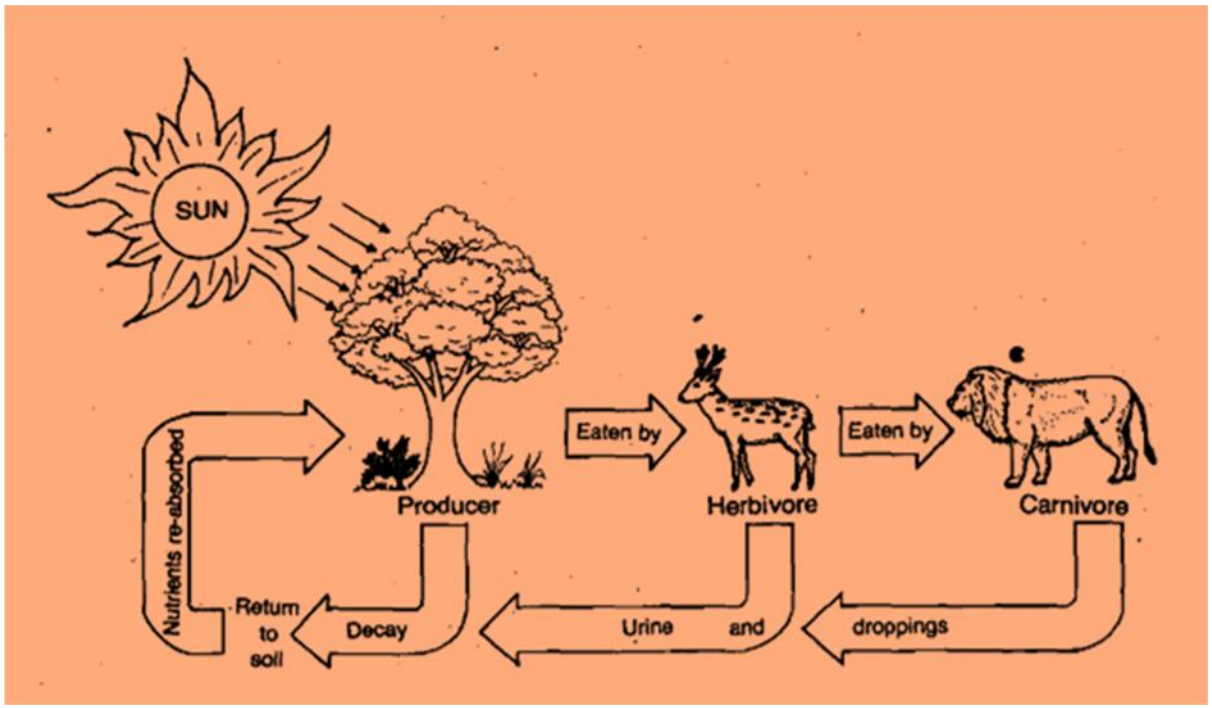

Fig: 1.4 Natural balanced ecosystem

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 trough 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: 1.5).

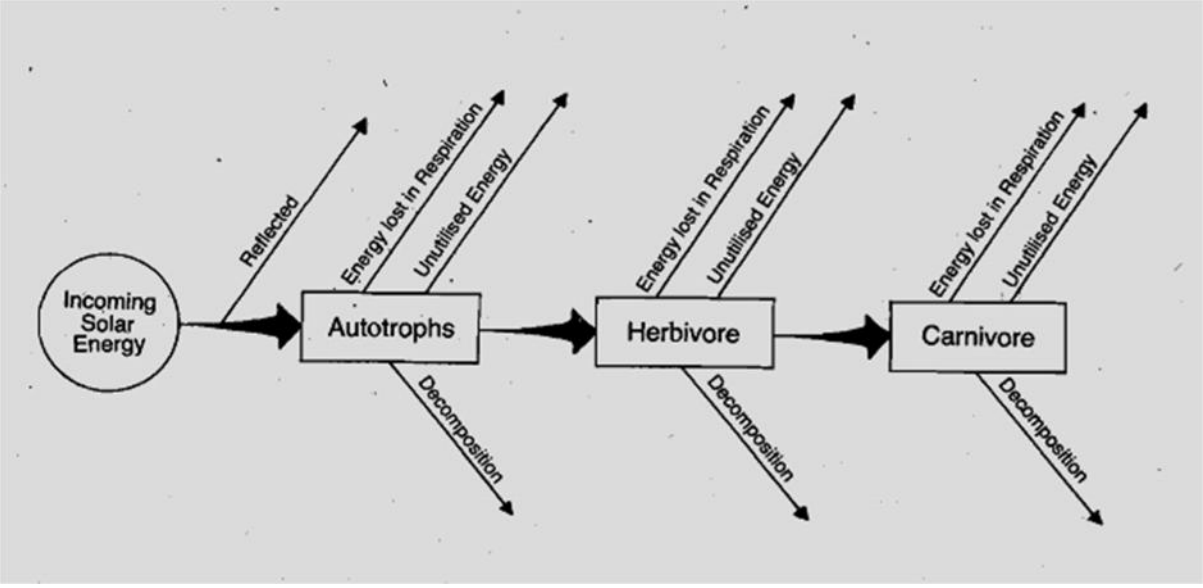

Fig: 1.5: flow of energy in ecosystem

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)

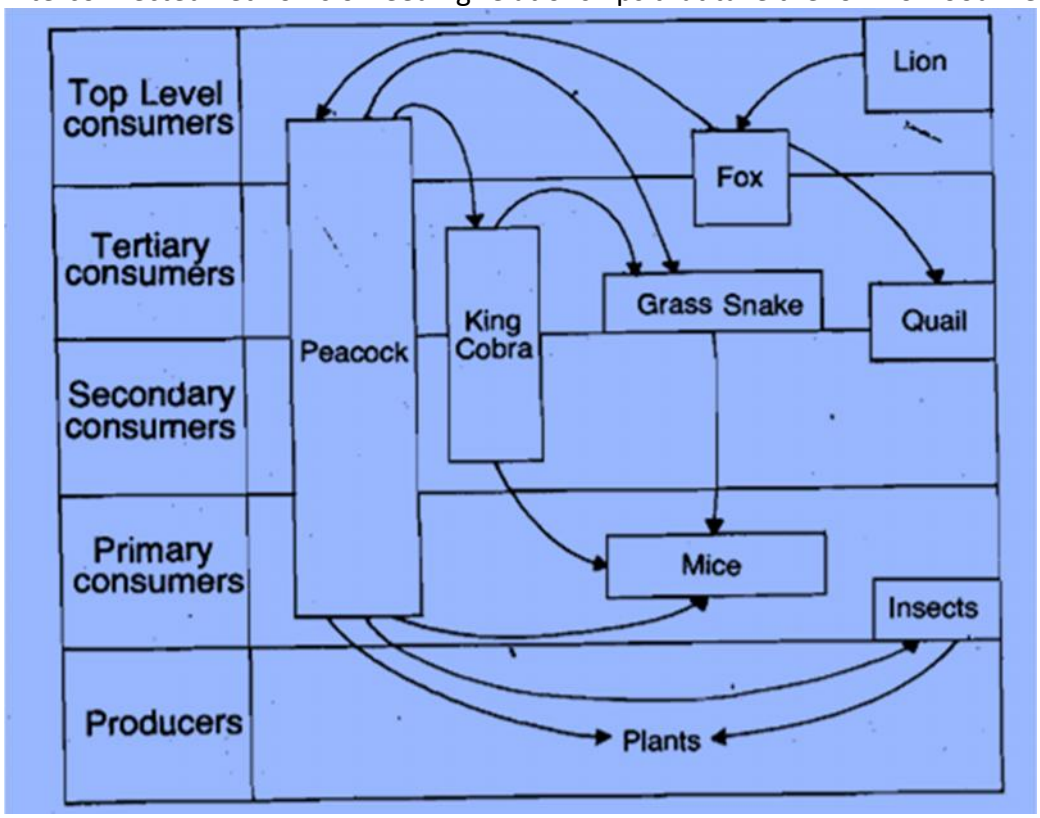

Fig: 1.6

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 maninacity.

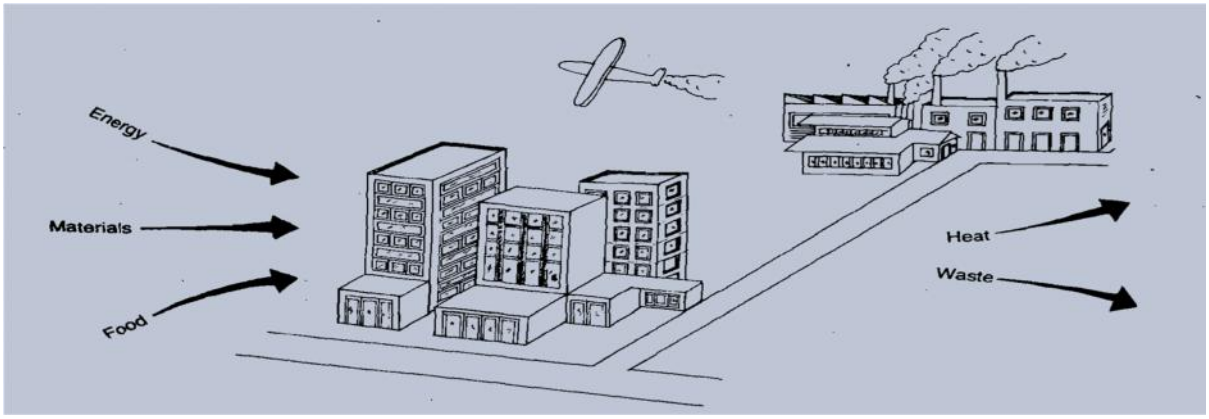

Fig: 1.7 manmade environment

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.

What Is Sustainable Development

Sustainable Development

'The world we have created as a result of our thinking thus far has problems which cannot be solved by thinking the way that we thought when we created them.'Source: attributed to Albert Einstein (Wikiquote undated)

The industrialised world has already used up many of the Earth's natural resources, and we are now realising that it will not be possible to carry on in the same way if we want to protect the future of our planet and those who live on it. However, it seems that with increasing technological abilities, we are better able to extract known, or find new, reserves. In addition, reductions in the material intensity of products − the amount of material needed to produce a product − has gradually declined. But, in many cases, the availability of resources should not mean that we do not have a problem with using that resource. For example, even though we seem to have 'enough' lead, the health and environmental effects of lead use still make a strong case against its persistent or increased use. Equally with fossil fuels: if we compare the carbon emissions that come from using fossil fuels (gas, coal, and oil) − mainly in the combustion engine and power stations − and which contribute to the greenhouse e□ect and climate change, then we are much more likely to exceed acceptable levels of atmospheric pollution before we run out of fossil fuels. Ultimately, all economic development depends on the Earth's natural resource base. Concern over the rate at which the Earth's resources are being used has led to the development of the concept of '**sustainable development**', a term that you will probably be familiar with. The most widely used definition of sustainable development, and one which you should remember, is that given by the World Commission on Environment and Development (WCED) in its milestone report Our Common Future (otherwise known as the Brundtland Report) in 1987 (WCED 1987). This is much quoted in defining sustainable development, but usually only the first part is quoted and not the second part, which is a critical qualifier to the first:'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:- The concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and - The idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs.' Source: WCED (1987) p. 43.There are also several clarifying definitions, for example, The United Nations Environment Programme (UNEP) defines sustainable development as'Development which improves people's quality of life, within the carrying capacity of earth's life support systems' Source: UNESCAP (undated) .The World

Conservation Union (IUCN) provides the following description of sustainable development: 'The guiding rules are that people must share with each other and care for the Earth. Humanity must take no more from nature than nature can replenish. This in turn means adopting lifestyles and development paths that respect and work within nature's limits. It can be done without rejecting the many benefits that modern technology has brought. Provided that technology also works within those limits.' Source: UNESCAP (undated).It is clear that to enable society to develop in a sustainable manner, an approach other than that which has previously been employed is required. Sustainable development will present the greatest challenge in the wealthiest nations, which consume the most resources, release the most pollution, and have the greatest capacity to make the necessary changes. However, leaders in some developing countries are suspicious of the concept, as they fear that the industrialised countries will dictate the development path that the developing countries must take; that is, the developing countries fear they will be penalised for the previous mistakes of the developed world.

Sustainable development requires a profound change in the goals and assumptions that drive corporate activities and changes in daily practices and tools. In other words, we need to develop an entirely new attitude towards environmental responsibilities. Business and industry have a vital role to play in determining the future of the planet and in working towards achieving sustainable development. This is recognised in the WCED report.

'Many essential human needs can be met only through goods and services provided by industry ... It has the power to enhance or degrade the environment; it invariably does both.' Source: WCED (1987) p. 182. For business, the concept of sustainable development presents a challenge - to produce higher levels of output while using lower levels of input and generating less waste. Organisations are now faced with the challenge of integrating environmental considerations into all aspects of their business, and environmental auditing is one of a number of environmental management tools, which enable them to do this.

The Earth Summit

In 1992, 176 governments sent delegates to the UN Conference on Environment and Development in Rio - known as the 'Earth Summit'. The Rio conference reinforced the importance of increased emphasis on environmental issues in every sector of the economy. Agenda 21 (UN 1992), the global plan of action, which was adopted at the Earth Summit, contains a chapter on the role of business and industry in securing sustainable development. Agenda 21 states that businesses should participate in a wide range of environmental management tasks, of which environmental auditing is one.

You have seen how worldwide developments in environmental consciousness have led to major changes in the way in which governments, investors, and the community at large perceive the importance of the environment. At the level of the individual organisation, these developments have meant

- tighter legislative controls
- constraints on the use of natural resources

- increasing pressure from customers and suppliers
- greater employee and management interest in the way the organisation approaches its environmental responsibilities

These factors have prompted organisations to seek new ways of integrating environmental considerations into all aspects of their business. In some cases this has been a requirement of regulatory bodies, while in other cases, a more proactive approach is taken and organisations voluntarily investigate ways of improving their environmental performance.

Between 26 August and 4 September 2002 the UN held a follow-up conference to the 1992 Earth Summit. This was the World Summit on Sustainable Development (WSSD) (UN 2002) and was held in Johannesburg, South Africa. The conference was set up to ratify, reinforce, and provide for stronger implementation of the many international agreements and conventions relating to environment and development. One of the key outcomes from the Summit included a range of commitments and targets aimed at achieving more effective implementation of sustainable development objectives (UN/DESA 2003).

Further Reading:

- ✓ ***An Introduction to Environment ,By Evelyn Talbott, Gunther F. Craun,(1995)***
- ✓ ***INTRODUCTION TO ENVIRONMENT ,By M. M. SULPHEY, M. M. SAFEER,(2014)***