

## Chapter-13

### Environment

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#### 13.1 Meaning of Environment :

The etymological meaning of environment is surround (French 'Environment' = to surround). In Webster dictionary environment has been defined as the group of all the conditions which affects the existence, growth and progress of an organism or a group of organism. Thus it includes all the components and conditions of the surrounding that affects the existence growth and progress of organisms. It can also be said that environment is a "Life Support System" because the existence and perpetuation of all the constituent organisms of the biosphere depends on it. The science related to the study of the mutual activities of environment and the organisms living there in is known as **Ecology**. Living beings remain embedded in their environment which (i.e. the environment) provides all the resources for its protection and perpetuation. The requirements for the support and continuity of living beings does not remain constant for the various phases of their life cycle-from birth to death, i.e. they are variable. Environmental factors are changeable with space and time. Hence at a given time and space, the existence and perpetuation of a living being depends on the integration of its ever changing needs and environmental rate of keeping up with them.

The physical, chemical, biological, scientific and technological components of the environment surrounding the living beings have been broadly categorized in the following three sub complexes :

- (a) Abiotic sub complex
- (b) Biotic sub complex and
- (c) Scientific and technological sub complex

There are many factors in each sub complex which affect each other at the complex level and thus all the three sub-complexes form the total environmental complex by interacting with each other. The living beings are supposed to be lodged in this complex. In his epic-Ramcharitmanas, Tulsidas

has considered the five abiotic components, i.e. earth, water, energy, space and air, to be the resource for the composition of living beings (Ramcharitmanas 4). The abiotic and biotic components of environment are being transformed at a large scale because of the changes brought about by the scientific and technological revolutions during the last century. It is because of this reason that the third subcomplex has been included. In it an artificial environment has been created for the living organisms. Haber termed it as the Tech-ecosystem in 1989.

This environment of the living beings can be in the form of natural, physical, chemical and biological form. The environment includes the fauna, flora and their related factors like - light, air, water, soil, sound, humidity etc. Earth's environment is also known as Biosphere. It includes Hydrosphere, Atmosphere and Lithosphere. Environment includes all the things that surround the living world and influence their life in different ways.

In Bharat, from vedic period only, there has been a tendency of exploration, testing and analysis of the environment. Its knowledge has also been described in the Purans, Veds and Upanishads. It has been mentioned in these scriptures that origin of human is from the five elements : earth, water, fire, space and air. Environment has been described in Vishnu Puran, Vrahat Samhita, Charak Samhita and Sushrut Samhita. Examples of environmental awareness have been mentioned at many points in the epics like the Ramayan and the Mahabharat.

Biotic and abiotic components are included in the environment. Biotic factors include animals, plants, micro-organisms and humans while abiotic factors include air, water, soil, temperature, moisture, topography etc. These components of the environment function together and keep coordination with each other and also transform each other's effects. Environmental studies include the study of its various components, including their

promotion, conservation and management.

### 13.2 Environmental Pollution :

The meaning of the words pollution and pollute as given in Oxford dictionary are as under :

**Pollute** : Contaminate (or make air, water etc. impure) with harmful or poisonous substances.

**Pollution** : The presence in or introduction into the environment of a substance which has harmful or poisonous effect.

Thus it is clear that pollution cannot be defined in exact words, however the word can be analyzed in order to form a concept of environment. Pollution is the unwanted change in the air, water, soil, biological creatures etc. which degrades the basic composition of these resources. It can have adverse impact on the biotic components, specially man, by bringing about direct or indirect changes in one or more abiotic components of the environment. Some pollutants like bad-odour, noise etc. can have psychological consequences. At times they become risky and hazardous for human health.

Pollution can be categorized into two types

- (1) Those which result in harmful changes, in the physical and chemical components of the environment, for man.
- (2) Those in which some new substances are incorporated in the environment by the modern industrial and technological activities of man. As compared to the first category of pollutants these new substances are negligible.

Increase in population is a direct attack on natural resources. Modern man believes that earth is made for man. He is authorized for the exploitation of resources. Our Father of Nation had said that "Earth provides enough to satisfy every man's needs but not every man's greed." Thus the prime reason for the exploitation of nature and the danger of pollution is the greed and ignorance of man.

If evaluated judiciously, it will be obvious that the fast growing population, unplanned destruction of forests, urbanization, industrialization, the blind-pace of development etc are the actual reasons of the ever growing pollution.

In Bharat, the awareness about nature has been there since Vedic times. Environmental conservation had been an integral part of life-practices in the entire Vedic and Post-vedic era.

Upanishads presents policies to conserve resources for our future generations. Samrat Ashok's inscriptions perhaps is the first record of wild life conservation. They reveal that Ashok had made hospitals and reserved areas for protection wild life and birds. The moghul attacks on our country were quite unfortunate, in the sense that it destroyed our social system to an extent that our ancestor's knowledge of times immemorial was concealed.

The so called development related to the technological revolution and blind-pace for technological development has set the concern for nature at backfoot. Neglect of long term benefits for humanity and the desire to obtain instant benefits have generated conditions which are having harmful effects on plants, animals and human-life.

#### 13.2.1 Air pollution

The air that forms the atmosphere is actually a mixture of various gases. It includes oxygen the life-giving, indispensable gas for respiration and other metabolic processes of living beings.

**Table 13.1**  
**Composition of Air on the basis of volume**

S.No.	Component	Percentage
1.	Nitrogen	78.09
2.	Oxygen	20.95
3.	Carbon-di-oxide	0.03

Other components include Argon, Krypton, Helium, Ozone, Carbon-mono-oxide, water vapour, Ammonia, Methane etc.

#### 13.2.2 Causes of Air Pollution :

Air pollution may be caused naturally or may have anthropogenic (caused by man) origin. Following are the natural causes of air pollution :

1. **Volcanic eruption** : In this gaseous pollutants such as Sulphur-di-oxide ( $\text{SO}_2$ ), Hydrogen sulphide ( $\text{H}_2\text{S}$ ), Carbon-mono-oxide ( $\text{CO}$ ) etc. are evolved.
2. Forest fires.
3. Marsh gases (like methane -  $\text{CH}_4$ ).
4. Products of natural decomposition of various organic and inorganic substances.

5. Suspended particulate matter.
6. Extra-terrestrial substances.
7. Cosmic-dust.
8. Allergens and irritants like pollens, spores etc.

Following are the examples of pollutants of anthropogenic origin :

1. Industrial effluents (discharge)
2. Vehicular effluents
3. Domestic effluents
4. Substances produced by burning of fossils
5. Explosives and other chemicals used in wars etc.
6. Various substances used in agriculture and agricultural practices.

#### **Effect of Air Pollution :**

These pollutants have adverse effects on human health. Given below are a few pollutants and their effects.

1. **Sulphur-di-oxide** : Chest congestion, headache, vomiting etc. Disorders caused by it may become fatal.
2. **Oxides of nitrogen** : They cease the activity of cilia. This is the reason why carbon and dust particles may reach the lungs causing various respiratory disorders.
3. **Hydrogen sulphide** : Causes irritation in throat and eyes and nausea.
4. **Carbon-mono-oxide** : It reduces the oxygen carrying capacity of blood and causes fatigue.
5. **Hydrogen cyanide** : If affects the nerve cells and results in dry throat, vague vision, headache etc.
6. **Ammonia** : It causes swelling in upper respiratory tract.

#### **13.2.4 Control of Air Pollution :**

Judicious and limited use of resources can control air pollution. A few strategies of controlling it, include :

1. **Adsorption** : It is a physical process that depends upon the surface properties of some substances. In it the flow of liquid and gas is coupled with a solid, so that the solid holds a thin film of the liquid or gas on the outside

surface - thus entrapping it. Activated charcoal, silica gel. Resin etc. are used as adsorbents. In this process the adsorbents may be reused hence it is an economic (thrift) process.

2. **Absorption** : This also is a physical process. In it the gases are allowed to dissolve in fluids. Water is the best solvent or medium for absorption.
3. **Condensation** : The gaseous vapours are controlled by condensation. It is the best method for removing the hydrocarbons having very low vapour pressure at ambient temperature, (i.e. air temperature of the surroundings). Air pollution can be satisfactorily controlled by using water or air cooled condensers.
4. **By chemical reactions** : Pollutants can be removed from the air by various chemical reactions.

#### **13.2.5 Water Pollution :**

Water is the most valuable resource of the planet earth, on which the life of all organisms depend. It is the main component of all living beings. In some organisms it forms upto 90% of the body weight. History reveals that all the great civilizations prospered on the banks of various rivers. Non-judicious use and wastage of water converted these civilizations into graveyards. Water provides natural beauty to landscapes and generates aesthetic beauty in them. It is the basis of entertainment and water sports. It is an important component for human health. Its pollution gives rise to many epidemics and water-borne diseases.

#### **13.2.6 Causes of water pollution :**

As in case of air pollution, even water-pollution has two reasons (1) Natural and (2) Anthropogenic. In the natural process of water pollution fusion of natural substances like salts, chemicals, minerals and products of the decomposition of the water soluble plant and animal products are involved. All of them are washed off to water bodies like ponds, lakes, puddles, rives etc. by the rain water and ultimately they may reach the oceans or ground water. The oceanic water is saline because accumulation of various salts which are

brought down to it, over centuries, by the ever flowing rivers.

The present day problem of water-pollution is the result of the modern industrial activities. Dirty domestic water, sewage water, sewage, urban wastes, industrial effluents, agricultural wash-out, oil-grease, decomposition products of the solid waste etc. when immersed in natural water bodies result in water pollution. The water soluble pollutants from air and land ultimately reach water bodies thus polluting them. The soluble effluents then may reach down to the ground water sources.

Various substances which pollute water by dissolving in it include : (1) Acids (2) Base (3) Coal (4) Dyes (5) Fats, Soap and waxes (6) Gaseous adjunct (dissolved gases) (7) Fertilizers (8) Insecticides (9) Weedicides (10) Farm products (11) Poisonous metals like mercury and its compounds (12) Synthetic detergents (13) Oil (14) Proteins and carbohydrates (15) Dissolved solids (16) Other organic pollutants (1) Poly chlorinated biphenyls (PCBs) (b) Phenol and phenolic compounds (c) Polynuclear aromatic hydrocarbons (d) Aldehydes (17) Radioactive substances (18) Thermal pollutants which include heated industrial waste water or water from the cooling towers of the nuclear power plants (19) Colours (20) Biological pollutants - Virus, Algae, Fungi etc. (21) Odour and (22) Turbidity etc.

All the fourteen big rivers of Bharat, including Ganga, Yamuna, Godavari, Gomti, Kosi, Kauvery, Ravi, Son, Chinaab, Jhelum, Narmada, Mahi, Tapti and Krishna are the victims of intense water pollution.

### **13.2.7 Effects of water pollution :**

If the pollutants accumulating in the oceanic waters cross the threshold, then the planktons which release nearly 60% of the photosynthesis oxygen of earth, will land into a condition of mismanagement and disaster. It will be very difficult even to estimate the harm caused by decrease in dissolved oxygen level to levels less than the biological oxygen demand.

### **13.2.8 Control of water pollution :**

Integrated water and waste management programs are required to get rid of the menace of water pollution. This approach comprises : (1)

Water treatment (2) Waste water treatment, (3) Waste water recycling (4) Product recovery. The following techniques of waste water treatment can be made use of :

- (1) Oxidation and stabilization ponds - The effluent water is stabilized in these ponds which gets oxidised in sufficient sun-light and hot-climate.
- (2) Treatment of sewage effluent water and reuse it for agricultural purpose.
- (3) Remove the pollutants :
  - (a) separation of salts by reverse osmosis
  - (b) removal of metals by electrolysis, ion dispersion resins etc.
  - (c) Controlled culture of water hyacinth (though it is very harmful for the existence of water bodies)
  - (d) Root zone treatment technique.

There is a need to have a water management policy, on a local level, with the aim of making available water for human consumption. Following measures may be taken for ensuring water availability :

1. Take proper measures to control pollution of puddles, rivers, rivulets, lakes etc.
2. Conservation of natural vegetation.
3. Improvement in the catchment area of rivers, rivulets, lakes, ponds etc.
4. Proper sewage treatment before immersing it in water bodies.
5. Construction of water reservoirs.
6. Development of underground water reservoirs on large scale.
7. Rain water harvesting.
8. Recharging the ground water and aquifers.

### **13.2.9 Soil pollution :**

Soil is the part of lithosphere which interacts with atmosphere, hydrosphere and biosphere. Thus it fulfils the fundamental requirements of terrestrial living beings. Soil provides the essential elements to planets which then produce organic substances from which the basic needs of human - food, cloth and shelter - are fulfilled.

In soil, different types of particles are present in different combinations and proportions. It

has inter-particulate spaces that are filled with air and water. If the soil is not well aerated, the spaces between soil particles get water logged and prevents the growth of the root system. This happens in soil which lack proper drainage and the soil becomes water logged.

### 13.2.10 Causes of Soil Pollution :

Soil pollution has resulted from the modern life style, and the human activities related to industries and agriculture. A few important sources of soil pollution includes :

1. **Industrial wastes/effluent :** The solid and liquid effluent from industries are spread on the soil without any type of pre-treatment. The fly-ash which spreads for miles harm the soil to a great extent. The minerals, chemicals, toxins etc. of the effluents pollute the soil and make it barren.
2. **Urban effluents :** Paper, glass, metallic boxes, plastic, fibres, food-waste, rubber, dyes, paint etc. are the solid urban wastes which pollute the soil to a large extent. The liquid urban wastes include the organic and inorganic chemicals, oil, grease, toxic substance etc. which spread on the soil and pollutes it. These effluents have pathogens which cause various diseases.
3. **Agricultural activities :** In-judicious, unforeseen use of chemical fertilizers in excess and excessive irrigation makes the soil water logged and devoids the soil of the essential nutrients. This makes the soil barren.

The concentration of soluble salts increases in the soil due to excessive use of chemical fertilizers every year. Such soils are known as the saline soil. If the sodium content of such soils increases they become alkaline and are known as the alkaline or sodic soil. Both the types of soils - alkaline and saline - are known as 'usar' in Bharat. They are the most unsuitable soil for agriculture.

In modern-agricultural practices, various chemicals like- pesticides (like DDT), fungicides bactericides and herbicides are used on large scale to protect plants from pathogens, diseases, weeds

etc. These chemicals do not decompose, in general and remain in the soil. Plants, at times, absorb them and they reach the higher trophic levels by means of the food chain. In this process, there is biomagnification of these substances and they become toxic for human consumption.

### 13.2.11 Noise pollution :

The sound energy, which flows in unit area of the medium in unit time, is measured in watt/meter square. The sound pressure can also be measured in Newton/meter square ( $N/m^2$ ). The loudness of sound is expressed in terms of a unit 'sone'. 1 Sone = 40 dB sound amplitude. 1 dB (decible) = 0.002 microbar sound pressure ( $dynes/cm^2$ ) - approx.  $10^{-16}$  watt energy. The range of human hearing may vary from 0 to more than 120 dB. Generally a sound of 80 dB is considered to be critical level to damage the ears. Therefore this and higher amplitude sounds are considered to be pollutant.

WHO (World Health Organization) has fixed 45dB as the safe noise level for any city. A sound level of more than 90dB for more than 10 milliseconds leads to aural reflex action and contracts the tympanic membrane. Sound of more than 140dB changes the direction of movement of ear ossicle, because of which the intensity of sound received by internal ear decreases. This protective reflex action can protect us from the danger of loud noise only for some time. On the basis of these facts 65dB has been accepted to be the limit to tolerance, in hospital areas, according to international standards.

Noise pollution affects human health, ease and efficiency. It may contract blood vessels and may increase the secretion of a hormone - adrenalin which generates blood pressure. This results in strained muscles which may lead to psychological tension, nervous disorder and madness. high level of noise pollution may lead to mental fatigue, high cholesterol level, heart attack and may damage brain, kidney, liver etc. and may cause long-lasting damage to the ciliated cells on the inner lining layers which may lead to deafness.

### Thermal Pollution :

The temperature of a natural water body increases if hot effluents are added to it, causing thermal pollution. This reduces the water quality

and harms aquatic and terrestrial organisms. The sources of thermal pollution include :

1. **Coolants of nuclear power plants :** The temperature of the effluent coolants of these power plants is on an average 10°C higher than the water entering the system. This affects the aquatic life adversely.
2. **Effluents of the thermal power plants:** These power plants use coal for generating electricity. For the purpose, water from nearest water body is made use of and then the effluent having a temperature of at least 15°C more is again sent to the water body. This warm effluent reduces the amount of dissolved oxygen which results in the death of fishes and other aquatic living beings.
3. **Effluents from the hydro electric power plants :** This is perhaps the only process of power generation in which there is negative thermal loading of a water system.
4. **Industrial effluents :** The cloth, paper, sugar etc. industries produce heated effluents which have a temperature that is approximately 8 to 10°C high. The effect caused by the temperature of these effluents depends on the original temperature and size of the water body.
5. **Domestic sewage:** The domestic sewage is immersed in water bodies without pre-treatment. Normally, the temperature of the domestic waste is higher and hence may increase the water temperature. This leads to reduction of the number of aquatic organisms. This may also lead to anaerobic conditions because of which fishes may die. Some of the physical and chemical changes and the adverse effect of thermal pollution on the biology of living beings and biological communities, includes :

(a) **Physical conditions :**

1. Increase in temperature
2. Increase in vapour pressure
3. Increase in the silting-rate of

suspended particles etc.

4. Decrease in density
5. Decrease in viscosity

(b) **Chemical conditions :**

6. Increase in chemical oxygen demand (COD)
7. Increase in biological oxygen demand (BOD)
8. Increase in toxicity

(c) **Biological effects :**

9. Changes in physiological activities
10. Change in Metabolic rates
11. Change in biochemical parameters
12. Interference in reproduction
13. Variation in the rate of reproduction
14. Increase in direct mortality of aquatic organisms.

(d) **Effect on Biological communities:**

15. The distribution patterns of living organisms change.
16. Unwanted changes in algal population.
17. Formation of water blooms by cyanobacteria.
18. Attack of destructive organisms.

In order to reduce thermal pollution the plant design should be altered to reduce the temperature of the effluents. The effluents produced may be cooled off to normal temperature before immersing them in water bodies. For the purpose special cooling tanks or towers can be constructed.

### 13.3 Ecology :

Environmental study is a part of ecology. The word ecology has originated from a greek word 'Oikos' which means 'a place to live' and 'logos' means 'to study' i.e. to study about the habitat of living organism. According to Ernst Haeckel (1868) "ecology is the mutual interaction of living organisms with its biotic and abiotic environment."

Each organism obtains different substances from the environment to survive. For example - oxygen is essential for respiration; similarly plants need carbon-di-oxide, water and sun-light for photosynthesis. The minerals required for plant growth are obtained from soil. Animals obtain their

food from plants and micro-organisms and human being obtain food from plants and animals.

Metals like copper, aluminium, iron etc. are used to make machines, utensils, ship, aircrafts etc. These metals are obtained from minerals. Coal, petroleum and natural gas are used as domestic and industrial fuel. In this way the living beings use various substances found on earth.

The substances required by living beings for sustenance of life are known as Resources. All the substances that are present in nature and are essential for the flow of life of living beings are known as **Natural Resources**. Air, wind, soil, vegetation, animals, minerals, sun-light, fossil fuel etc. are natural resources.

### 13.4 Ecosystem :

It is the structural and functional unit of biosphere and is characterized by self sustenance. i.e. ability to continue a healthy state without outside assistance. It is an open system and depends on sun-energy. Ecosystems may be small or big. There is a continuous exchange of minerals and energy between neighbouring ecosystems. Hence, all the ecosystems are interlinked and inter related. The web of inter-linked ecosystems is known as the **biosphere**. The term 'ecosystem' was first of all used by a British Ecologist Arthur Tansley in 1935. It is made up of biotic and abiotic components. According to Eugene P. Odum (1963) ecosystem is the basic unit of ecology in which the biotic and abiotic components interact with each other and both components are important for the continuum (uninterrupted existence) of life. Animals are holozoic and do not prepare their own food; they depend - directly or indirectly - upon plants for their food requirements. Although plants synthesize their own food yet they depend on various abiotic factors. From a broader perspective, the earth we live upon is itself a giant ecosystem whose various biotic and abiotic components interact with each other. It is because of this reason that structural and functional changes occur continuously in the ecosystem. Although it appears to be impossible to control the entire Biosphere but to facilitate its study it can be subdivided into various ecosystems.

### 13.5 Structure of Ecosystem :

Ecosystem is made up of two main

components biotic and abiotic.

**(1) Abiotic components :** It includes inorganic, organic and climatic factors like - air, water, soil, sun light etc.

**(i) Inorganic substances :** It includes nutritive elements and components like - carbon, nitrogen, sulphur, phosphorus, carbon-di-oxide, water etc. They are cycled in the ecosystem.

**(ii) Organic compounds :** It includes proteins, fats, carbohydrates, humic substances etc. They are basically related to the living body and connect the abiotic and biotic components.

**(iii) Climatic factors :** They are of two types -

(a) Environmental factors like sun-light, temperature, humidity, precipitation etc.

(b) Edaphic factors like topography, soil texture etc.

**(2) Biotic components :** The living components of the environment are known as the biotic components. They can be further categorized as producers, consumers and decomposers.

**(i) Producers :** These are the chlorophyll containing plants which include algae, grass, trees etc. They convert solar energy into chemical energy during photosynthesis. They are the source of food for majority of animals. They are also termed as **autotrophs** as they synthesize their own food.

**(ii) Consumers :** These are the organisms which cannot synthesize their own food and depend on other organisms for their nourishment. They are known as the **consumers** and are **heterotrophs**. Mostly they are animals. Animals which directly depend upon plants for their food are known as **herbivorous**. For example - grass hopper, goat, sheep, rabbit etc. The

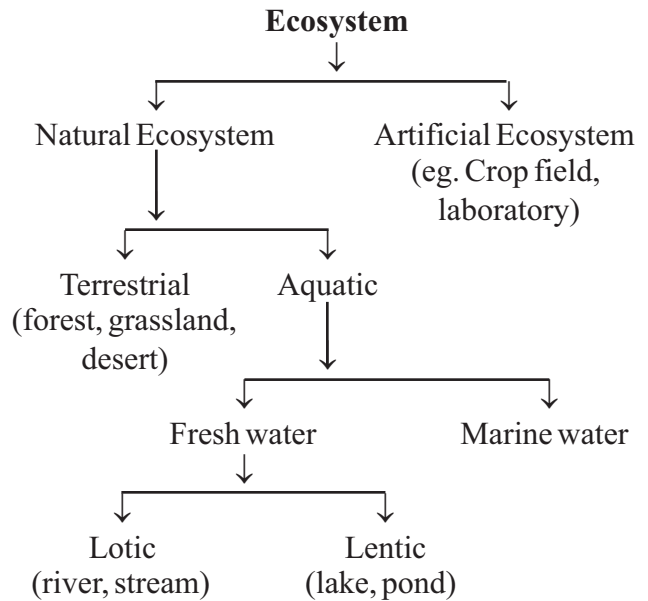
animals which depend upon herbivorous animals for their food requirement are known as **carnivorous**. For example snake, lion, frog etc. They may be **predators** or **parasites**. The animals which can derive their food from both plants and animals are known as **omnivorous**. For example - cockroach, man etc.

(iii) **Decomposers** : This category mainly includes bacteria and fungi. In an ecosystem bacteria generally work upon the animal tissue while fungi on plant tissue. They digest dead organic matter with the help of enzymes and in this way the basic elements of the cell components are released into the atmosphere, which are then reused by producers.

### 13.5.1 Types of ecosystems :

Ecosystem are of two types :

1. **Natural ecosystem** : They are naturally under their own control and are self sustained with the human interference of the least order.
  - (a) **Terrestrial ecosystem** : Example- Forest, grassland, desert etc.
  - (b) **Aquatic ecosystem** : They are of two types (i) Fresh water and (ii) marine water. The fresh water ecosystem again may be of two types lotic (example - river, streams etc.) and lentic (example - pond, lake etc.).
2. **Artificial ecosystem** : These ecosystems are man-made and are under their control. Example crop-land which includes fields of wheat, bajra, rice etc. Here man tries to control the biotic community and physico-chemical factors. Apart from the above systems, even the space eco-system has been recognized.



### 13.6 Biogeochemical cycle :

The harmony between the biotic and abiotic components of the biosphere keeps it dynamic and stable. There is transfer of substance and energy between the various components of biosphere due to this co-ordination. Let us consider the various processes that keep this balance.

#### 13.6.1 Water-cycle

You have seen how it rains following vapourisation of water from water bodies and then there condensation. But we have never seen the seas and oceans drying. Then how is water replenished in these reservoirs.

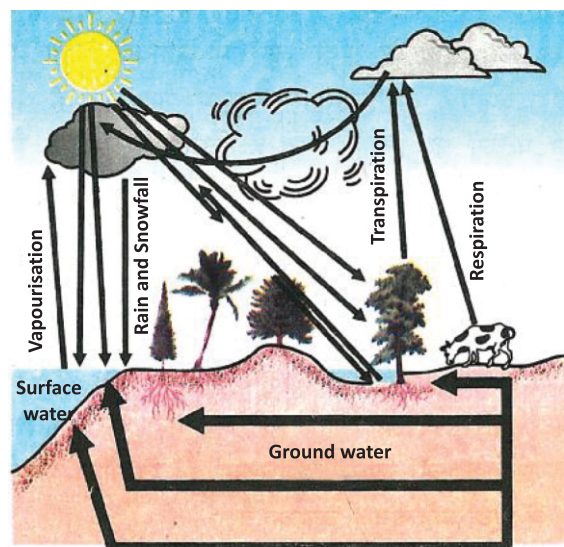


Fig 13.1 Water cycle in nature



The entire process by which water forms water vapour, forms clouds and then comes back to the earth surface in the form of rains and then flows into the oceans is known as the water cycle.

This cycle is not so easy and simple as it appears to be by the statement given. All the water that comes down to earth does not directly flow into the oceans. Some of it percolates into the soil and forms part of the water table. Some of this ground water flows out in the form of streams on the earth surface or we bring it to the surface through wells and tube wells. For the various life processes the terrestrial living beings use this surface water. (fig. 13.5.1)

As is a well known fact, water dissolves many substances. When water flows through soluble minerals some of them dissolve in it. These are then carried over to oceans by water flowing in the rivers and rivulets and they are then used by the aquatic flora and fauna.

### 13.6.2 Oxygen cycle :

Oxygen is one of the most abundant element on earth. Its quantity is nearly 21% of the atmospheric gases. It is also present on a large scale, on the earth surface, in the form of water and other compounds and in air in the form of carbon-di-oxide also. It is present in the form of metal and silicon oxides in the earth's crust. It is also present in the form of carbonate, sulphate, nitrate and oxides of minerals. It is an essential component of biomolecules like - carbohydrates, proteins, nucleic acid and fats or lipids.

But when we talk about oxygen cycle, we are basically concerned with cycle that keeps the oxygen levels in nature balanced. Oxygen from atmosphere is used in three processes - Respiration, combustion and formation of oxides of nitrogen. Oxygen returns to the atmosphere by only one process i.e. photosynthesis. This forms the outline of oxygen cycle in nature.

Although we consider oxygen to be of importance in the respiratory process but for some organisms, mainly bacteria elemental oxygen is toxic. Actually nitrogen fixation does not take place in the presence of oxygen.

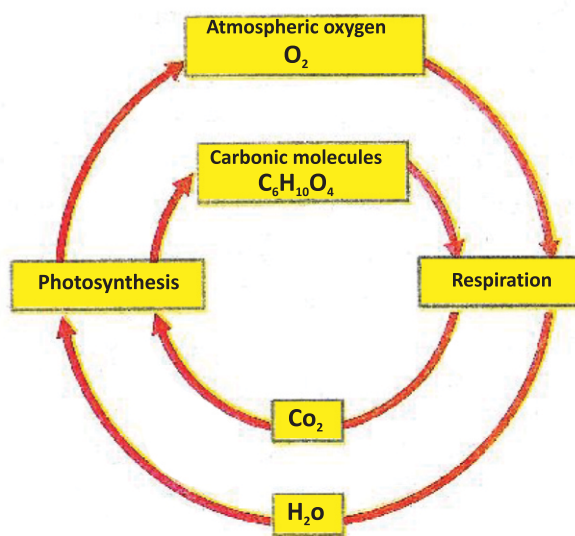


Fig. 13.2 Oxygen cycle in nature

### 13.6.3 Carbon cycle :

Carbon is present on earth in various states. It is present in the form of diamond and graphite in its original form. In atmosphere it is present in the form of a compound - carbon-di-oxide; carbonates of various minerals and hydrogen carbonate. Furthermore, all the life forms are based on carbon-based molecules like - proteins, carbohydrates, fat, nucleic acid and vitamins. The exo and endo

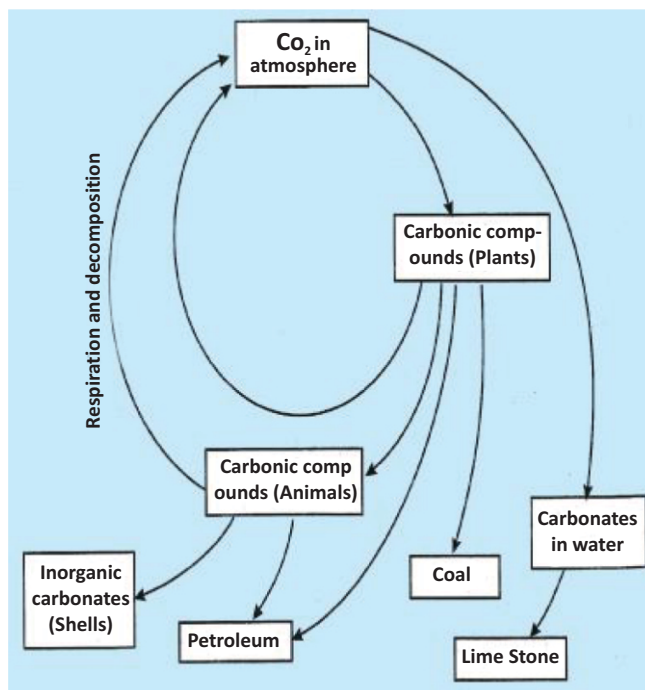


Fig. 13.3 Carbon cycle

skeleton of many organisms is made up of carbonate salts. Carbon is incorporated in various forms of life through the process of photosynthesis which takes place in the presence of sunlight in the chlorophyll containing plants. The carbon-di-oxide present in the atmosphere or in dissolved form in water is converted to glucose by the process of photosynthesis. These molecules of glucose either convert into other molecules or provide energy for the synthesis of other important molecules.

Glucose is used in the process that provides energy to living beings. Glucose is oxidized to carbon-di-oxide, with or without oxygen, by the process of respiration. The carbon-di-oxide thus formed goes back into the atmosphere. Carbon-di-oxide also enters the atmosphere through the process of combustion where fuel is used to cook food, warm it, or in transportation and various industries. Actually after industrial revolution man started using fossil fuels on a large scale, to the extent that the amount of carbon-di-oxide in atmosphere has nearly doubled. Like water even carbon is recycled by various physical and chemical processes.

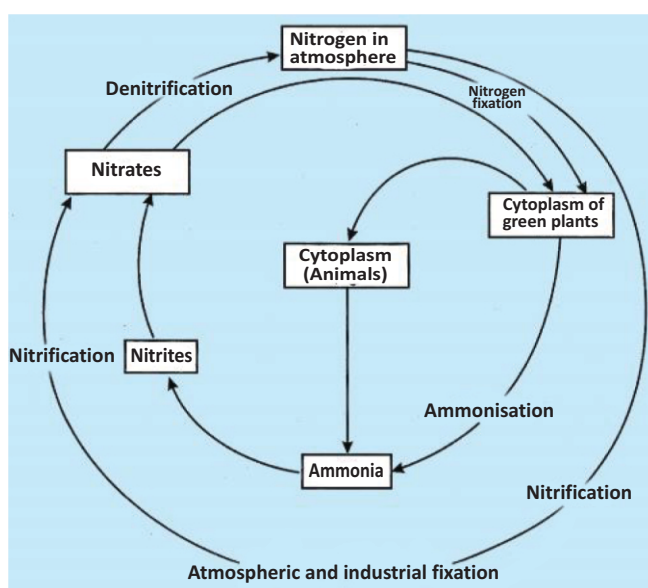
### 13.6.4 Nitrogen cycle :

Nearly 78% of our atmosphere is made up of nitrogen gas. This gas is the component of many molecules essential for life. For example : proteins, nucleic acid - DNA and RNA and some vitamins.

Nitrogen is found in other bio molecules also like alkaloids and urea. Thus nitrogen is an essential nutrient for all organisms. The life would be simple if all the organisms use nitrogen present in the atmosphere, directly. But this does not happen in nature. Apart from some bacteria, most of the other organisms are unable to convert the inactive nitrogen into nitrates, nitrites etc. "Nitrogen fixing" bacteria are found either as free living forms or in symbiotic association with some types of dicots. Generally, these nitrogen fixing bacteria are present in special root nodules of pod bearing plants. Apart from these bacteria, the nitrogen atoms also form nitrates and nitrites by various physical reactions. The high temperature and pressure generated in the atmosphere at the time of lightening, converts nitrogen to oxides of nitrogen. These oxides dissolve in rain water and form acid which fall on earth surface; then after it is used by various life

forms.

What happens to nitrogen after it forms various nitrogenous molecules. The plants, generally, absorb nitrates and nitrites and convert them into amino-acids which are used in protein synthesis. There are some other bio-chemical options which are used for synthesis of other nitrogen containing complex molecules. These proteins and other complex compounds are then used by the animals. When the plant or animal die, various bacteria present in the soil converts the nitrogenous compounds into nitrates and nitrites and other type of bacteria break down these nitrate and nitrite molecule into nitrogen element.



**Fig. 13.4 Nitrogen-cycle in nature**

Thus in nature there operates a nitrogen cycle in which nitrogen, passing from its basic form in atmosphere converts into simple molecules in the soil and water and then in living beings it forms very complex compounds. Later-on they break down, releasing the nitrogen atoms back into the nature.

### 13.7 Green House Effect :

In a glass house, the internal temperature is very high as compared to the external temperature because the glass does not allow the heat waves to transmit back in the atmosphere. This concept is made use of in maintaining, warm tropical plants in the cold climate. This type of cover is known as a green house.

Similar, phenomenon occurs in the

atmosphere too. Some gases prevent the escape of heat into the outer atmosphere. Increase in the amount of such gases in the atmosphere may rise the average temperature of the earth's atmosphere. This type of effect is known as the **green house effect**. Carbon-di-oxide is a green house gas. Increase in the amount of carbon-di-oxide in the atmosphere will increase the heat content of the atmosphere. These activities lead to global warming.

### 13.8 Ozone layer :

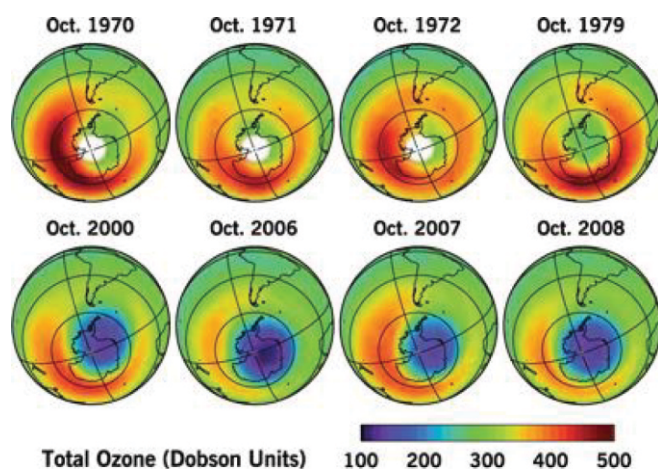
The elemental oxygen is generally present in the form of bi-atomic molecule. However, in the upper layer of atmosphere tri-atomic molecules are also present. Its formula is  $O_3$  and is known as ozone. In contrast to the biatomic oxygen molecules, the ozone is toxic. We are lucky that ozone is unable to remain near the surface layers of earth. It absorbs the harmful radiations of the sun. Thus it prevents those radiations from reaching the earth surface which may harm various life forms.

Recently, it has been detected that the ozone layer present in upper atmosphere is degrading. Different types of compounds, made by man, for example the chloro-fluoro-carbons (CFCs) are present in the atmosphere in a stable state. CFCs are chlorine and fluorine containing organic molecules. They are very stable and do not degrade even by biological processes. Once they reach near the ozone molecules, they react with them. This results in decrease in the amount of ozone and this leads to thinning of the ozone layer. Recently ozone hole has

been observed above Antarctica. It is very difficult even to think about the hazardous effects the life on earth will be subjected to, in the absence of this ozone layer, which is thinning rapidly. Serious efforts are required to be undertaken to protect it.

#### Important points

1. Environment is a "Life Support System" because the existence and perpetuation of all the components of the Biosphere depends on it.
2. The existence and perpetuation of a living being at a given place and time depends on the harmony between the speed of the ever changing needs of the living being and that of the environment.
3. The biotic and abiotic components of environment are being transformed on a large scale because of the changes brought about by the scientific and technological revolutions of the past century.
4. Environment is also known as the Biosphere. It includes Hydrosphere, Atmosphere and Lithosphere.
5. Environment includes the (i) biotic and (ii) abiotic components.
6. Pollution is the undesired change in the physical, chemical and /or biological characteristics of air, water, soil, living beings etc. which degrades the raw nature of the resources.
7. Man-made pollutants includes : Industrial effluents, vehicular effluents, domestic effluents, substances produced by burning fossil fuels Explosives and other chemicals etc. used in battle field, substances used in agriculture and other agricultural activities.
8. The modern day problem of water pollution is the result of activities of modern industrial civilization.
9. Integrated water and waste management programs are required to combat the problem of water pollution.
10. In soil there are different types of particles which are connected to each other in different proportions. There exist spaces between these particles which are filled with air and water.



**Fig. 13.5** Satellite pictures showing ozone hole above Antarctica.

11. World Health Organization has decided that the limit of upto 45dB is the safe limit of noise for a city.
12. Thermal pollution results from increase in water temperature due to addition of hot effluents in a natural water reservoir. This reduces water quality and harms the aquatic as well as the nearby terrestrial life forms.
13. According to Ernst Haeckel (1868) Ecology is the mutual relation of living beings with their biotic and abiotic environment.
14. The substances required by living beings for remaining alive are known as the resources. All the substances which are present in the environment and are essential for the flow of life are known as natural resources.
15. Ecosystem is the basic unit of ecology. The biotic and abiotic components present therein interact with each other and both are important for the perpetuation of life.
16. **Decomposers** : They mainly include the bacteria and the fungi. In an ecosystem bacteria usually degrade the dead animal matter while the fungi are responsible for the degradation of plant material.
17. **Artificial ecosystem** : These systems are controlled by man; for example cropland which includes wheat, bajra, rice fields etc.
18. Oxygen is used in the atmosphere during the three basic processes of respiration, combustion and formation of oxides of nitrogen.
19. Nitrogen fixing bacteria are either present free in nature or in symbiotic association with some species of dicotyledonous plants. Generally, these nitrogen fixing bacteria are present in special root nodules of pod bearing plants.
20. Some gases prevent the escape of heat from the earth's atmosphere. Increase in the quantity of such gases can increase the average temperature of the atmosphere. This effect is known as the Green House Effect. Carbon-dioxide is an example of green house gas present in the atmosphere.
21. Various compounds like chloro-fluoro-carbons (CFCs) which are produced by human being, remain stable in the atmosphere. CFCs are organic compounds containing chlorine and fluorine. They are very stable and are not

degraded naturally. They harm the ozone layer, which forms a protective cover around earth.

## Questions

### Objective type :

1. Which of the following is not an air pollutant :  
(a) Marsh gases (b) SO<sub>2</sub>  
(c) CO<sub>2</sub> (d) DDT
2. Who coined the term ecosystem?  
(a) Odum (b) Tansley  
(c) Haeckel (d) Haber
3. The main gas responsible for the Green House effect is :  
(a) CO<sub>2</sub> (b) SO<sub>2</sub>  
(c) NO<sub>2</sub> (d) CO
4. Which of the following is an artificial ecosystem :  
(a) Forest (b) Grassland  
(c) Desert (d) Cropland
5. Adsorption, absorption, condensation etc. are useful for the control of which type of pollution:  
(a) Air (b) Water  
(c) Thermal (d) Soil

### Very short answer type questions :

6. Define the term 'ecology'.
7. Write the names of two main air pollutants.
8. What are decomposers?
9. Define noise pollution.
10. Write the chemical conditions produced by thermal pollution.

### Short answer type questions :

11. Write the names and examples of the abiotic components of the ecosystem.
12. What is Global Warming?
13. What is artificial ecosystem ? Give example.

### Essay type questions :

14. Explain the causes and effects of air pollution.
15. Give a schematic description of the nitrogen cycle.

## Answer Key

- 1.(d) 2.(b) 3.(a) 4.(d) 5.(a)