UNIT 33 OUR ECOSYSTEM AND THE THREATS TO IT

Structure

33.0 OBJECTIVES

After studying this Unit you should be able to:

Conceptualize an ecosystem;
discuss the interrelations of the various components in our ecosystem;
explain the impacts of human society on the environment;

enumerate and discuss the current global, local, and the contemporary and emerging environmental issues;
describe the salient conservation efforts in the light of sustainable developmental approach.

33.1 INTRODUCTION

The relationship between human society and the environment is of mutual dependence. The earliest human society lived by hunting and gathering, and the effects of these activities on the environment were either negligible or imperceptible. With the developing human society beginning to use fire, domestication of grazing animals, and setting up of the permanent agricultural systems about 10,000 years back - all their cumulative effect on the environment began showing up. These effects were discernible largely in the form of disturbed vegetation and animal life. Further, in the 18th century the industrial revolution and the use of fossil fuels, began to dramatically change the environment. And the situation, as of today, is familiar to almost all of us. There is hardly any one around the globe, who has not heard of or felt `concern' for the `fast changing' environment. It is important to note that all the changes that have occurred in the environment are not of anthropogenic origin. Several `changes' have been going on naturally at a slow pace, throughout the developmental history of the Earth. It is mainly due to these natural `changes' that favourable conditions for the survival and proliferation of amazingly diverse life forms have resulted. Our worry is not for these slow, natural processes, but for some of the activities of the human societies that are detrimental to the environment. These activities have brought about changes in the environment that are either too fast for the environment to cope with, or of such kinds that are very difficult if not impossible to rectify or remedy. It is not our intention to make this unit another gloomy talk about environmental degradation. Instead we shall make an objective analysis of the reasons and the ways of `development of the present state of the environment' which is described as grave ecological crises.

33.2 EARTH - THE LIVING PLANET

Earth is a unique planet in the entire solar system that supports life It has provided the right environmental conditions for the survival, multiplication and evolution of amazingly diverse life forms. All life forms are confined to a narrow zone of over a dozen kilometers broad, stretching from the ocean depth to a few kilometer into the atmosphere, all round the globe. This zone is known as **biosphere** (Fig. 1). To have a clearer mental picture imagine if the Earth were of the size of an apple, the biosphere would be only as thick as its skin.

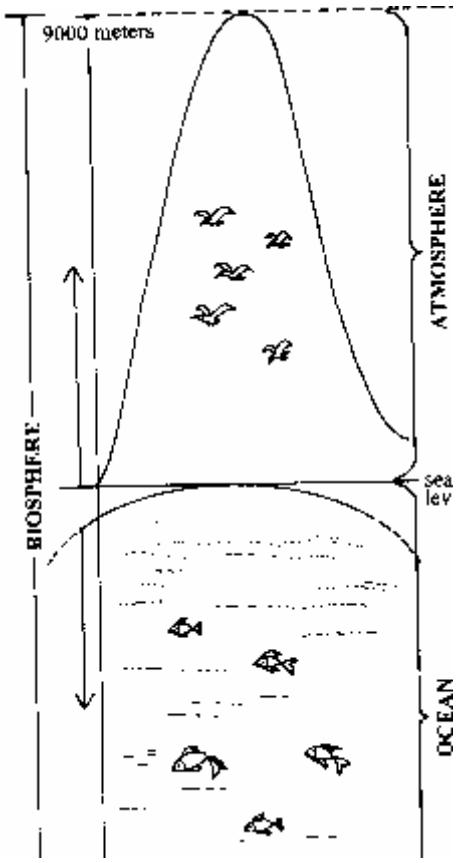


Fig. 1 : Diagrammatic representation of the extent of the biosphere. It extends from the floor of the ocean, i.e., some 11000 meters below the Earth's surface, to the top of the highest mountain or about 9000 metros above the sea level. Life is scarce at the extremes of the biosphere because of less-favourable environmental conditions.

33.2.1 The Environment

In the above paragraph, a reference has been made of the `right environment'. What is meant by the term environment, and what are all the components that form it? This needs to be understood first. The term environment is used in diverse ways, such as the `natural environment', `man-made environment', `human environment' and so on. Its usage in different contexts refers to different situations, but in all the cases its basic constitutive elements remain the same. Three basic elements comprise the environment - the physical, the chemical and the biological elements. The first two elements are collectively described as the non-living elements. The environment in the context of a particular living being, say a sparrow, refers to all the factors that affect it from outside. These factors are **Physical** - light, temperature, moisture etc.; **chemical** - all the chemical elements some of which form the nutrients; and **biological** - other living beings present around it. It is the environment from which a living being derives all its requirements, be it food, nutrients or energy.

Related to environment is another term - **habitat**, the meaning of which should also be clear to us. Habitat refers to the place or the type of site where an organism or population naturally

occurs. In the subsequent sections of the unit you would come across a number of habitats that are important to mankind in different ways.

33.2.2 Organization of Life Forms

The biosphere includes three distinct parts : (I) the **atmosphere** - air; (ii) the **hydrosphere** - water bodies; and (iii) the **lithosphere** - land. These three parts overlap each other and are interconnected through their inhabitant life forms as well as the processes associated with them.

The land portion or the lithosphere is divisible into a number of **biomes**. These represent large region characterised by their climate, vegetation pattern, animal life and the general soil type. About a dozen or more biomes spread over millions of square kilometers spanning the entire continents. NO two biomes are alike, e.g., temperate forests are markedly different from deserts, which in turn are clearly differentiable from tropical rain forests and grasslands (Fig. 2).

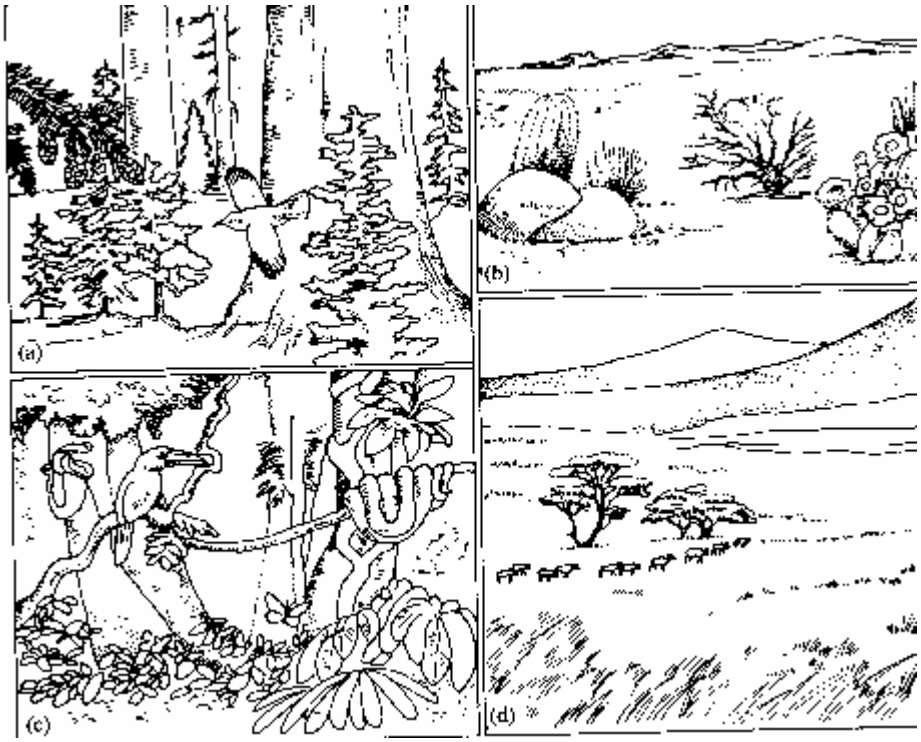


Fig. 2 : Diagrammatic representation of four kinds of biomes. Note, each biome has a distinctive set of features that enable one to differentiate one biome from the other. (a) The temperate forest biome; (b) the desert biome; (c) The tropical rain forest biome; and (d) The grassland biome.

Similarly, the sea is also divided into distinct life zones such as coral reefs, estuaries, deep ocean and continental shelf. These regions like the biomes have varying physio-chemical conditions and likewise the characteristic plant and animal life.

Coming back to the terrestrial biomes, let us take the example of a grassland. It may be further subdivided into smaller units - such as areas having tall grasses, or water-logged areas having

different kinds of grasses and so on. In each of these two areas, specific kinds of animals based on their preference for a particular kind of grass, are found. Similarly, two or more ecologically different systems may exist in a biome.

Ecology: It is the science of the relations of the organisms to their surrounding exterior world.

33.2.3 The Ecosystem Concept

The biosphere, the biome and their constituent units, that we have discussed in the previous section - each one of them is an ecological system, which in short form is written as ecosystem. An ecosystem is defined as a **dynamic complex of all the life forms and their non-living environment interacting as a functional unit**. These life forms include all the plants and animals, and even the communities of microorganisms that inhabit the given area. In simpler terms, ecosystem is a unit of nature that in itself is an independent functional entity (Fig. 3). Going by definition, the biosphere, the Earth, a forest, a river and a small pond - each one is an ecosystem. This means the complexity and size of ecosystem varies, and a larger ecosystem may have smaller ecosystems. An ecosystem is what one chooses for one's study.

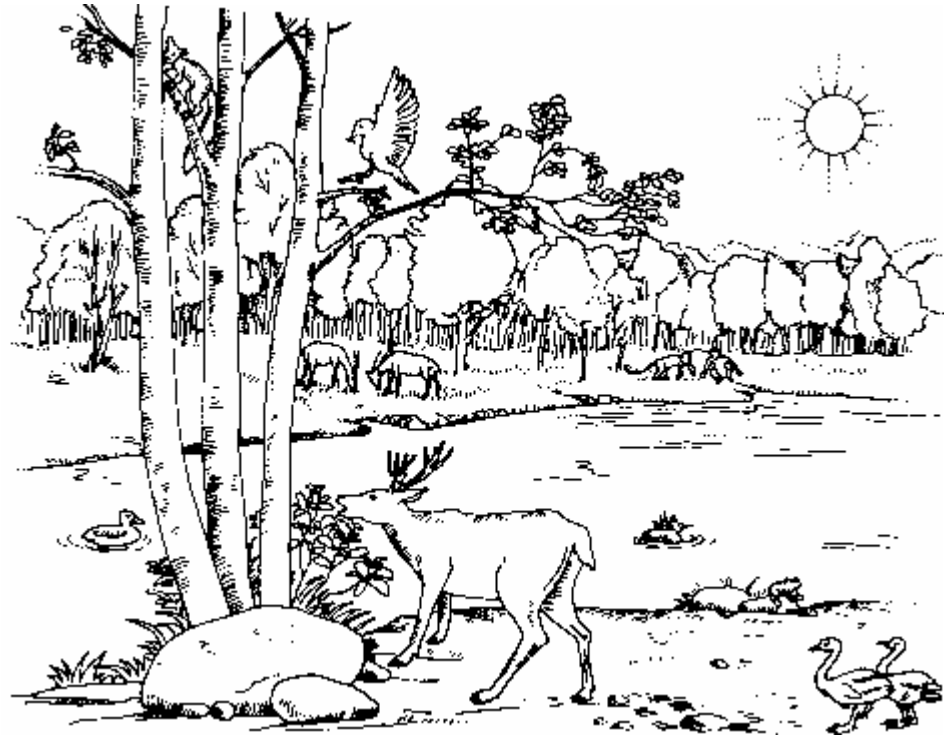


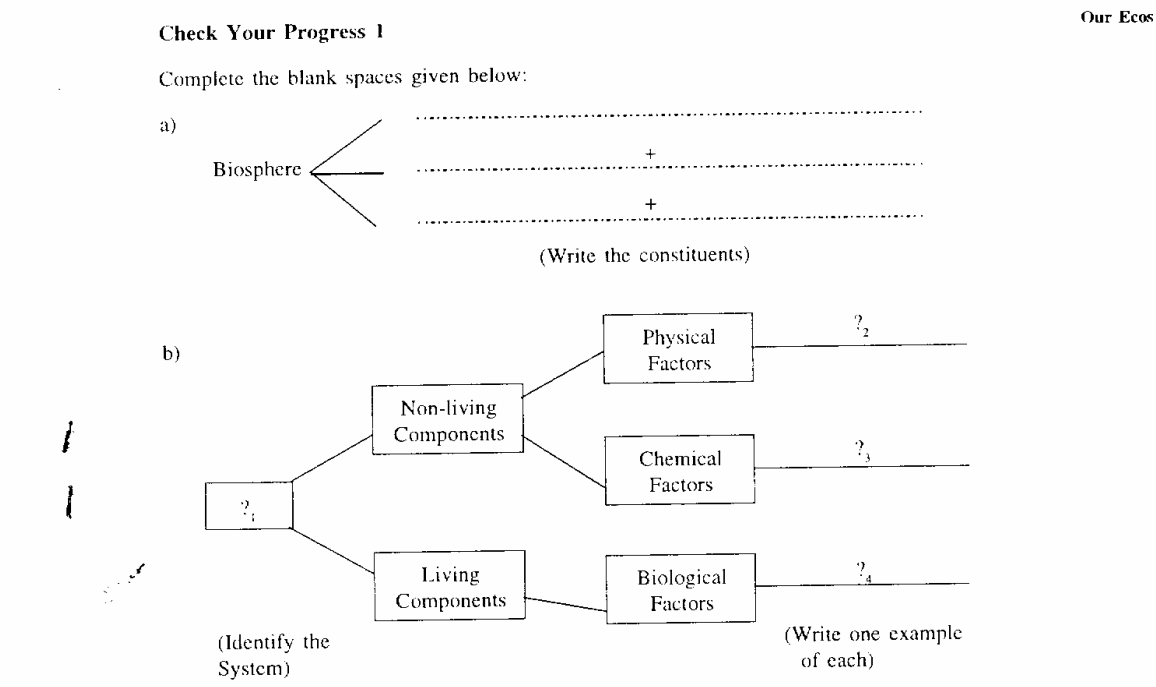
Fig. 3 : A forest ecosystem. Note the different kinds of living beings and the non-living environmental factors constituting it.

Ecologists recognise two types of ecosystems - **Natural** and **anthropogenic ecosystems.** The former are those ecosystems that are undisturbed by humans. On the other hand anthropogenic ecosystems are those that have been significantly altered by human beings through agriculture, forestry, livestock, grazing, constructing home on green areas and many such activities. Of course, the most severely altered ecosystems are the places where cities are built.

It is important to know that `ecosystem' is a concept, and no distinct ecosystems with sharp boundaries exists in nature. The knowledge of an ecosystem enable one to understand the kind of disturbance or an `ecological problem' of an area. If one knows how a particular ecosystem functions in undisturbed conditions, what kinds of interactions exist amongst its life forms, and in what manner the living beings are dependent on the physico-chemical or non-living factors, proper remedial steps can be taken to restore normalcy in the disturbed ecosystem, or at least further damage to the ecosystem can be prevented.

Check Your Progress 1

Complete the blank spaces given below:



Check Your Progress 2

a) Differentiate between the environment and the habitat?

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b) Which of the following statements are **true** for an ecosystem? Choose the correct answer from the **codes** given below:

i) Ecosystem is the short form of ecology.

ii) It is a dynamic entity of nature.

iii) It is composed of all the living and non-living components.

iv) Ecosystem by itself is an independent unit.

v) Ecosystems have distinct differentiating boundaries.

vi) Anything can be considered an ecosystem, e.g., a chair, a fountain pen or a room with furniture and other accessories.

Codes

1) i ; v ; vi

2) iv only

3) ii; iii; iv

4) none

33.3 GLOBAL ENVIRONMENTAL ISSUES

> "The ability of our minds to imagine, coupled with the ability of our hands to devise images brings us a power almost beyond our control" - Joan McIntyre.

The agricultural and industrial developments on one hand have ushered in food security and comfortable living to human society, but on the other hand have also contributed in the degradation of our environment in diverse ways. Any degradation or disruption of the environment means degradation of the life support system. Since the last two decades our life support system is being increasingly marginalised due to a number of environmental problems. So much so that these have emerged as a potential threat to the existence of human society. Never before has there been such pressing need to reconcile and analyse the environment-society relationship, as for the last 20 years or so. For too long the environment was taken for granted, natural resources were utilized as if they were infinite, and wastes were dumped indiscriminately in the biosphere. But the biosphere like any container has a certain capacity to hold the wastes, beyond which no more can be contained. Wastes generated by different activities of the human society have been accumulating in the biosphere over the years, and their repercussions have appeared as diverse kinds of environmental problems.

From this section onwards, we begin discussion on a range of environmental issues of present times - local, associated with a particular region/nation, some of global occurrence and impact, and the contemporary and emerging issues. The local environmental issues are as important as the global ones, as the whole environment is a continuum. There are no water-tight compartments. The air we breathe is common for all, and even all the oceans are connected. The natural processes in one part of the globe have their governing factors located n some other region, e.g., the rain in this continent has its origin in another distant continent. This is just one example of the intricate ecological networking. Several such instances are cited in the following sections. The

environmental issues whose repercussions are of global consequences, are discussed in this subsection.

33.3.1 The Changing Atmosphere

This is emerging as the most threatening environmental issues of 1990s. The build-up of **dust veils**; enhanced **greenhouse gases**; and **ozone depletion** are the three main agents of this change.

Dust is particulate matter that is temporarily suspended in the atmosphere

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A) Dust Veils

Since the last century human activities involving combustion of fossil fuels, deforestation, overgrazing, motor vehicles exhaust emissions and military practices have resulted in increased dust loading in the atmosphere. Dust also gets loaded into the atmosphere due to the naturally occurring volcanic activity. Now, the question arises that how is the dust veil responsible in bringing about a change in the atmosphere? The dust particles suspended in the atmosphere act as a blockade to the incoming solar radiations, and these are scattered back to the space. Consequently, the Earth's surface on not receiving the usual quota of sunshine becomes cooler. Thus the role of dust is envisaged in causing global cooling. Such interpretations are based on the computer assisted studies of climatic modelling. Credence is also lent to this deduction from the role of dust in the Little Ice Age. So the far remains that are we in for another Ice Age?

B) The Greenhouse Effect

The greenhouse effect is a natural phenomenon, whereby the `greenhouse gases' present in the atmosphere absorb radiant energy from the Sun - both incoming as well as some that is radiated back from the Earth's surface. These gases behave as a glass in the greenhouse or the glasshouse, that lets in the heat from the Sun, but prevents some of it from being radiated out (Fig. 4). As a result, the temperature inside the glasshouse is higher than outside it. Likewise this process keeps the Earth at a higher temperature than it would be otherwise. Also this makes conditions appropriate for existence of life on this planet. This is why some call Earth as **The Greenhouse Planet.**

what are the greenhouse gases? **Carbon dioxide** (CO_2) is the prime agent that is produced naturally by volcanic activity and through respiration of living beings. In addition, it is generated in huge amounts by several of the human activities such as burning of fossil fuels in different sectors, from motor-vehicle emissions, and so on. The other one is **methane** (CH_4) produced by bacteria in swamps and marshes; and another is **nitrous oxide** (NO) that is generated by denitrifying bacteria. IN addition, a new group of greenhouse gases were identified in the 1940's. These are the **Chloro-fluoro-carbons,** written in short form as the CFCs. Their role in ozone depletion would be discussed below. The CFCs have been found to be 20,000 times more effective in greenhouse activity than that of Carbon dioxide.

The data since the last century have shown a clear increase in the amounts of the greenhouse gases in the atmosphere. And these trends continuing, prediction is made of warmer climates for the planetary ecosystem, by the mid of the next century. The resultant increase of about a mean of

3°C in global temperature is speculated. The overall break-up being as follows: an increase of 1°C or slightly more at the equator, around 3°C in temperate latitudes, and from 4.5-7°C at the poles. This much rise in temperature has not occurred in this planet since the Mesozoic era - the age of dinosaurs.

Temperature shifts of this order could affect the rainfall patterns, overall climate change accompanied by shifts in vegetation and agricultural pattern, disappearance of the ice peaks of the Arctic Ocean during summers, resultant changes in the sea-levels, risk of losing many low-lying areas such as portions of Calcutta, Florida, Tokyo, London, Stockholm, Glasgow, Osaka, Montreal, parts of Bangladesh and many others.

You may be wondering that on one side we talk of global cooling and then of global warming, wouldn't these two processes counteract one another. This may be partly true, but the balance could shift to the more weightier one, or towards the severest of the problem.

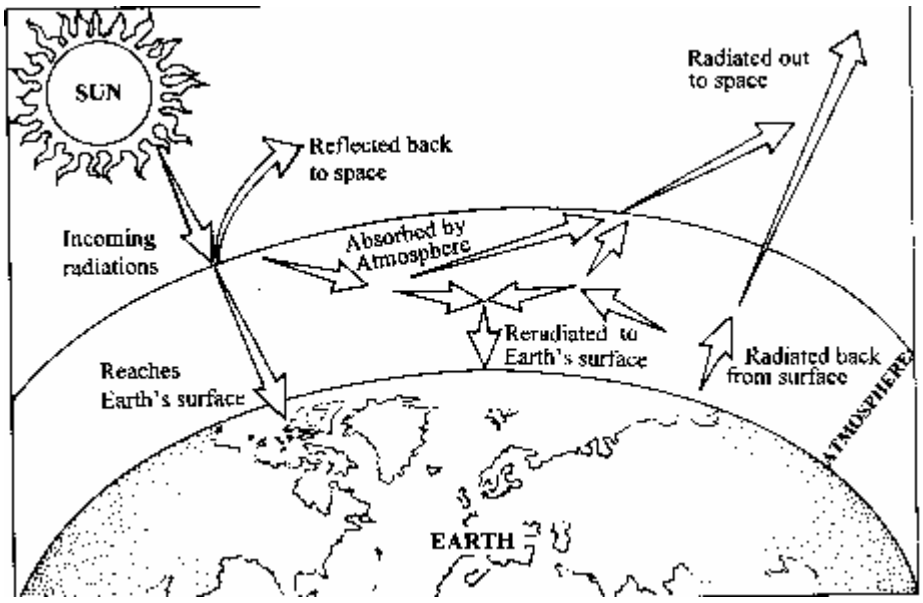

Fig. 4 : The Greenhouse effect - a diagrammatic representation. Note the role of atmosphere in trapping heat radiation that would otherwise escape into the space.

C) Ozone Depletion

In the years 1984-85, another major environmental issue came to the fore, that is, the discovery of the `ozone holes' over the Antartica. What are these `Ozone holes', let us understand it first. Ozone (O_3) is present in the stratospheric layer of the atmosphere between 20 to 30 km from the sea level. Ozone formation and depletion goes on simultaneously in the atmosphere. It is formed when the Ultraviolet solar radiations (UV) react with the oxygen (O_2) of the atmosphere, and gets depleted due to its participation in a number of reactions going on in the atmosphere. Nevertheless, a `sheet' of ozone remains in the atmosphere, which shields the living beings on the Earth from the harmful effects of the solar radiations. In recent years, what has happened, and is still happening,, is that the ozone depletion has been accelerated by several of the human activities. Of which wide usage of the CFC is the main cause. In addition, bromine used in

industrial processes and fire extinguishers is yet another cause. The CFCs are produced from a wide range of sources namely industries involved in preparing spray can propellants air conditioners foam blowing agents, refrigerators, and foam-hard plastics. The large scale build up of ozone destructors in the atmosphere has resulted in "gaps" the ozone shield, and these gaps are termed as the **ozone holes**, which extend up to several square kilometers. And through these regions, the harmful solar radiations mainly the UV radiations enter the atmosphere unchecked and unfiltered. The harmful effects of the UV radiations include undesirable changes in the genetic material of living beings, which in the human beings leads to the development of skin cancer. Already there are reports of high incidence of skin cancer in the `ozone-deficient' areas. Besides humans, recently it has been found that the genetic material of a species of icefish found in the Antarctic region has been damaged. Even the tiny, single-celled plants of this area are also not spared of the ill effects of the UV radiation pouring through the hole in the ozone layer.

The discovery of `ozone hole' became a matter of international concern. This resulted in the signing of **The Montreal Protocol** in September 1987, and it took effect in 1989. This is the **first** international agreement signed on an international issue. It makes it legally binding for curbing all chloro-fluorocarbon emissions for the protection of the stratospheric ozone. Initially, it aimed at a 50% cutback in the production of CFCs by 1999, but an interim review of the situation, resulted in imposition of a **total ban on CFC production by the year 2000.**

Species - A population of individuals that resemble each other and are capable of interbreeding with one another, but not with members of another populations (species).

33.3.2 Deforestation

The removal of plant cover whether in a forest or in a grassland or in any other area is another major ecological problem of global dimension. The term deforestation is used to denote this process. It is important to understand that this term is being used in a wider context, and it refers to all kinds of biomes and not the forests alone.

The forests, as we all know, are vital organs of the biosphere. Besides maintaining the quality o soil they also play a part in modulating the climate of this planet. In addition their economic importance and aesthetic value is no less. They are also the homes of millions of people and a huge pool of plant and animal species, many of which are yet unknown to us.

Deforestation is a rampant ecological problem that despite receiving a lot of attention during the last decade, still continues at an alarming rate. This is especially true in the tropical regions where some 154 million hectares were cleared during 1980 to 1990. This leaves only 1.75 billion hectares of forests worldwide. India's forest cover has declined from 50 per cent to about 19 per cent since 1900.

What are the causes of deforestation? The commercial timber extraction and other forest products go into various human uses. The richer nations and societies siphon out a larger chunk of these resources. Forest clearing is also occurring in order to convert the land for farming and raising livestock. Large tracts of vegetation get depleted as a result of mining activities, hydro-electric power schemes, laying of roads and for military purposes.

Deforestation has both local as well as global consequences. The first consequence is demolition of habitat of a number of species. Secondly, there is an increased exposure of Earth to the mechanical effect of rain and run-off, this leads to soil erosion and reduced soil fertility due to loss of nutrients and soil structure. Deforestation is intimately linked to disasters like downstream flooding and flash-floods which have been of common occurrence in Bangladesh and Garhwal-Himalayas respectively. Another important effect seen at local level is reduced local groundwater levels and water shortages in local wells and springs. All this happens because in the absence of vegetation cover, not much water is absorbed to the water table, but most of it just runs off. The run-off also carries with it the fine soil particles - the silt to the rivers and the irrigation works. The silting of reservoirs and lakes and that changes in river courses have become common in recent years. Flooding and accompanying siltation affects fisheries, reduces the capacities of dams and irrigation systems.

Deforestation has two serious repercussions at the global level. These are: firstly their role as carbon sinks in the global carbon cycle, and secondly as pools of biodiversity. The implications of the loss of biodiversity cannot be assessed, but loss of species lead to the loss of potentially important genetic characteristics. For example, many of the world's medicines come from pants of tropical regions where large-scale deforestation is taking place. Also the success achieved through breeding new strains of many important plants such as cocoa, rubber, coffee, rice and corn has come about after incorporating genes from their relations growing in the wild.

33.3.3 Marine Pollution

The seas and oceans constitute a major component of our biosphere, and occupy about seventy one per cent of the Earth's surface. They are important to the human societies in several ways. They are the resource base for food, metals and minerals; source of energy generation, for fulfilment of water needs; as a medium for transportation; for military, tourism and recreation purposes. In addition, they are also used as `environmental sink' or as a sort of `waste-bin with infinite capacity' for disposal of any or almost every kind of waste. Though the seas and oceans have immense containing capacity, but still it is finite. Innumerable kinds, and amounts of wastes have been finding their `terminus' in these huge `sinks' for centuries. Now the situation has come to a pass that no more could be taken in silently as various types of ecological disturbances in the marine environment have started showing up. You may be thinking that why the seas or the marine ecosystem have been treated in such a manner especially when the human society is dependent on them in a number of ways? This is a complex issue involving a number of factors. However, the prime factor for their misuse is that they being **Common Property Resources (CPR)** are freely misused and mindlessly exploited with no one liable for the damage caused. The areas beyond a country's jurisdiction, that is, the high or open sea and the deep sea bed are the actual CPR. These are the soft targets for all kinds of exploitation, that have resulted in a number of ecological problems which are commonly referred to as marine pollution. What is marine pollution? The GESAMP (United Nations Group of Experts on the Scientific Aspects of Marine Pollution) defines **marine pollution?** as "the introduction by the people directly or indirectly, substances or energy into the marine environment resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities, including fishing, impairment of quality of use of sea water and reduction of amenities". The next question that follows is what are the chief sources of marine pollution? A variety of sources causing pollution can be categorised as **degradable** and persistent **wastes**. Degradable wastes are derived from food processing, brewing, pulp/paper/chemical industries, oil spillages, chemicals used in agriculture, heat or cooling water discharges; whereas persistent wastes include heavy metals,

DDT and radioactive materials. Many of these wastes are dumped directly into the sea or some are brought by the river flows. Some of these wastes are extremely harmful for example, routine discharges of liquid radioactive effluent from the Sellafield Nuclear Reprocessing Plant have made the Irish Sea the most radioactively contaminated the vicinity of the coastline, then most of the sea-life of that area including the sea birds, local fisheries, and other life forms are destroyed. The oil easily penetrates the plumage of sea birds making their flight impossible, therefore a large number of them cannot swim or float and die due to drowning. In addition, oil is also highly poisonous to the marine life, and a large number of them die after its ingestion. The unhygienic conditions of sea water at the beaches due to tourism; and the coastal zones with large population and industry contribute pollutants in the coastal water in a big way.

In the recent years, mariculture or aquaculture has brought in a `Blue Revolution'. It is an aquatic resource-based industry involved in large-scale growing of marine organisms for human use. Though it is a relatively new industry. It has generated enormous controversy because of the resultant environmental damage it has caused to the coastal marine environment. It has resulted in problems at the social front too. How? The mariculture industry being highly profitable, attracted almost every large business house in India. Even middle level investors moved in to make a quick buck. The mariculture- industrialists occupied the coastal land without any respect for the local people's rights. Even burial grounds were not spared. All the local resources were freely "exploited" by this industry. And in several cases, fishermen were denied the traditional passage to the

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Accidental marine pollution caused by Supertanker disasters have resulted in serious ecological crises disturbing vast areas of the seas. The oil spill figures of the following four Supertanker disasters would give you an idea of the magnitude of the problem.

i) ***Torrey Canyon*** *(Cornwall & Brittany, 1967), Oil spilling - 117000 tonnes;*

ii) ***Amoco Cadiz*** *(Brittany, 1978), Oil spilling 233000 tonnes;*

iii) ***Exxon Valdez*** *(Alaska, 1989), Oil leaking - 11.2 x 106 tonnes along 3800 km coastline;*

iv) ***Mega Borg*** *(Texas, 1990), Oil leaking, 500,000 gallons.*

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sea. In most areas of mari-farming, this industry was found to violate all basic principles of sustainable development, that is, social acceptability, equity, economic viability, technical appropriateness, environmental soundness and conservation of natural resources. They use all natural resources with contempt without taking any responsibility for damage caused. Within a short span of setting of these industries, a number of environmental problems came to light- the fragile water balance both on the surface and in the underground acquifers were adversely affected, vast tracts of land were rendered salinized; and coastal water became highly polluted due to the largely organic-matter rich effluents from this industry. In view of the environmental damage caused; the Supreme Court ordered in December, 1996 the closing down of **all** commercial aquaculture farms in the five coastal states of our country. Not only that, the Court also ordered strict compliance of the **coastal Regulation Zone (CPZ) Act-19991**. Under this Act, aquaculture farms located within the 500 meters of the high tide line (HTL) are illegal and thus the Court ordered them to be removed by April 15, 1997. Such a step had to be taken because the

damage caused was much higher than the sale of the coastal aquaculture produce. We hereby are not advocating outright condemnation of aquaculture. But what is actually required is that while learning from our experiences and errors, and keeping in mind the socio-economic ground realities, a sustainable eco-friendly aquaculture should be practiced.

33.3.4 Energy Needs

For the modern, energy-intensive life style, there is a global requirement for cheap and plentiful energy resources. The source and process of energy production and its subsequent uses have resulted in a number of environmental problems. First let us have a glimpse at the world energy picture, which is quite variable in different parts of the world. The developed world uses far more enrage than the developing world - nearly twice as much, despite having far smaller population. Each person in the developed world, uses on an average six times as much energy as a person from the developing world. The `energy use' here refers to the overall usage - in work place, domestic appliances, private cars and so on. You might have also observed that the more affluent the people become, more energy they require. They have a fleet of private vehicles, all sorts of luxury items including the while goods such as refrigerators, washing machines etc., and bigger homes with more energy consuming devices.

Coming back to the various kinds of `energy resources' used all over the world, they are being viewed with the following concerns; How long will they last? Will they be available for the future generations? What are the by-products given out during energy production? And what is the enrage cost on the economies of different parts of the world? The developed and developing world use different resources or fuels for energy production. The **biomass fuels** are the major source of energy for the developing world. Wood, charcoal, crop residues and other plant residues, are the commonly used biomass fuels. Nearly half of world's people depend on biomass fuels to meet with their energy requirements, and they use very little or no oil, electricity and other commercial fuels. A major portion of these fuels are used for cooking purposes, and are usually gathered from the local environment.

The **fossil fuels** have been the most widely used energy resources since the industrial revolution. Coal, oil and natural gas collectively constitute the fossil fuels and are produced in the Earth's crust by the process of fossilization. The fossil fuels, no doubt have higher energy yields as compared to the biomass fuels, but they emit a variety of pollutants. Coal is not only dirty to handle but is far more polluting than oil and natural gas. The large proportion of greenhouse gases emitted into the atmosphere is attributed to the usage of coal. The acid-rain problem, you will study in the following section, in Europe is associated with coal-fired power stations. Natural gas is the cleanest of fossil fuels that gives higher energy yields. Also it emits lower levels of pollutants as compared to other fossil fuels. In recent years two major concerns are being raised the world over regarding the use of fossil fuels. The first of course, concern the environmental implications of their usage. The second one is about the status of their natural stocks which would govern their availability in the coming years. A number of studies in the recent years have raised doubts about the availability of these resources to match the rising demands. This warns us on two fronts, one judicious use of what is available to us, and second, its high time to search for substitutes.

Nuclear energy constitutes another source of energy whose use is limited largely to a few developed countries only. Safety, cost of production and disposal of nuclear wastes are the crucial issues of nuclear energy production. Safety became the prime issue in nuclear energy generation after the Chernobyl accident on April 26, 1986, in the former USSR. It is the worst nuclear

accident todate. The Chernobyl fallout caused contamination in the Soviet Union, and large areas of Ukraine were rendered uninhabitable. Not only that, the nuclear fallouts carried by wind affected vast areas of Europe. Across the Baltic Sea in Sweden, radiation brought large-scale destruction to the home of nomadic Lapps, who follow the herds of reindeer which roam the plains of Lapland. The dairy farming regions in the centre of the Sweden have been seriously affected too. Back to the Soviet Union, the nuclear radiations consisting of large amounts of Iodine-131 and Cesium-137 contaminated the soil and water resources and were also absorbed by all forms of life. Whatever is absorbed by plants from the soil and water is passed on to animals and finally the human beings, and leaves its legacy in the food chain - for such radiations have active-life span over thousands of year. Not only these radiations are invisible but cannot be immediately felt by touch or smell. The poor and uninformed people whom circumstances force to live amid contamination are the worst hit.

The nuclear radiation cause irreparable damage to all kinds of life forms, some of the diseases caused by exposure to radiations are: cataracts; bleeding gums; stomatitis, or mouth inflammation; keloids, i.e., growth of scar tissues and contraction deformity; erythema or reddening of skin; cancer of lungs, stomachs, breasts, colon; leukemia, bone marrow damage, malignant lymphatic tumors and hyperthyroidism.

It is pertinent to mention here that the dangers of nuclear radiations are not only from the nuclear power plants, but also from the atom bomb dropped from above, the atomic explosions conducted in the atmosphere or underground, nuclear reprocessing plants, nuclear research centres, and the mining and processing of nuclear materials. To put it in simple terms whether it is nuclear weapons or production of electricity from nuclear sources, the dangers of nuclear radiation are alike. The tragedy due to the atomic bomb dropped at Hiroshima and Nagasaki in Japan is still fresh in our minds. In 1946, a number of children in Japan were born with a condition known as microcephaly. The children had abnormally small heads and were mentally disabled. This condition resulted because their mothers who were pregnant were exposed to radiation near the site of blasts in Hiroshima and Nagasaki.

In the recent years, greater awareness has resulted in public opposition to nuclear power; so much so that in U.S. and Western Europe it had forced cancellation of new nuclear power plant construction.

While energy generation from fossil fuels and radioactive materials has been the **conventional mode,** a large number of **unconventional modes** have also been successfully tried. These include solar, wind, hydro, geothermal, tidal and biomass resources. Many of these have been found to cause almost negligible environmental damages but these too can be taken care of at the project design and construction stage.

The rising energy demands and projected energy needs in the coming years can not only solely be met by constructing newer power plants, but the unconventional methods of power generation are to be made more efficient and economical. There is also need of cutting down energy wastes by using energy efficient appliances, avoiding wasteful practices and adapting/developing a conservation attitude. There is also a compulsory need of **energy auditing system**. Japan has a system of compulsory energy auditing for all business whereby they have to produce energy efficiency plans which are approved by the government agency. In India too, it is mandatory under Company's Law that all manufacturing companies give information regarding the efforts made for conservation of energy in their Annual Balance Sheets. The need is that such an

auditing system permeates to larger spheres, and if people voluntarily adopt the usage of this introspective device a sustainable energy future is ensured.

33.3.5 Population Pressure

The population and environment have an intimate yet complex linkage. One may be tempted to believe that there is a direct relationship between the two. That is, more the

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In India the major nuclear energy plants are: Tarapur Atomic Power Plant (Near Mumbai), Rawatbhata (Rajasthan), Kalpakkam (Chennai), Narora (U.P.), Kakrapara (Gujarat); and in Kaiga (Karnataka) the project is under construction.

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people, more are the resources required, and consequently more wastes burden the environment. It is not as simple as that. The socio-economic factors direct this relationship. According to an estimate, the developed world containing a quarter of world's population having little or no growth, yet produces about three quarters of the world's wastes. Why is it so? Actually, it is the high living standards of the developed societies, which has a greater bearing on the state of the environment. Their way of life is energy intensive as it involves high consumption of goods and services. You may recall the environmental repercussion at the global scale, of various modes of energy production, that is discussed in the previous sub-subsection. Therefore, it is not the population growth, but the rise in living standards and the associated practices that accelerate environmental degradation.

Another important factor in the relationship of population growth and environmental degradation in increasing trend of growth of urban living. There is large scale movement of people n rural areas to cities in search of jobs and better standards of living. A study by United Nations has predicted that of the 24 cities with over 10 million inhabitants by the year 2000, 18 would be in the developing world. It further points out that 60% of the population in the developing world would be urbanized by the year 2025. In such situations where people concentrate in dense settlements, not only there is a great pressure on the local environment, but also in rural areas, both their economy and environment are adversely affected. It may be remembered that many of the essential provisions for life, such as materials for food, shelter and clothing are obtained from the rural areas only. Coming back to the burgeoning urban populations, through their diverse production activities for earning money to buy items for sustenance, and luxurious lifestyles, generate large, localized amounts of waste materials. The waste materials are difficult to deal with, without environmental damage, especially in countries with scarce financial and technical resources.

Poverty also has some bearing on the environment. The poor people, confined in large numbers in the developing world, are forced to damage the environment in long-term to ensure their short-term survival. Such an environmental damage is often an indicator of underdevelopment, and also a cause of further underdevelopment as it damages both the means of production- the environment, and the human beings which are dependent on, and use that environment, To sum up, in the developed world the main force leading to environmental damage is the pressure to consume and to increase consumption, whereas in the developing world the main force is the pressure to produce to survive.

Check Your Progress 3

What are the casual agents of each of the following environmental problems? List them in the blank space provided.

a) Dust veils

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b) Greenhouse Effect

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c) Ozone Depletion

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Check Your Progress 4

a) In what manner deforestation affects the ecosystem?

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b) Comment on the use of Seas and Oceans as `Environmental Sinks'. Your answer should include both the positive and negative aspects.

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Check Your Progress 5

a) Complete the table given below. In case the space provided is not sufficient, you may use a separate sheet.

Source	Examples (materials used)	Effect on the environment	Rating*
Biomass fuel	?	?	?
Fossil fuel	?	?	?
Nuclear Source	?	?	?
Unconventional Sources	?	?	?

* Rate each source with + signs to show their relativeness as cleaner sources of energy.

b) Is there any link between population pressure and environmental quality? Discuss.

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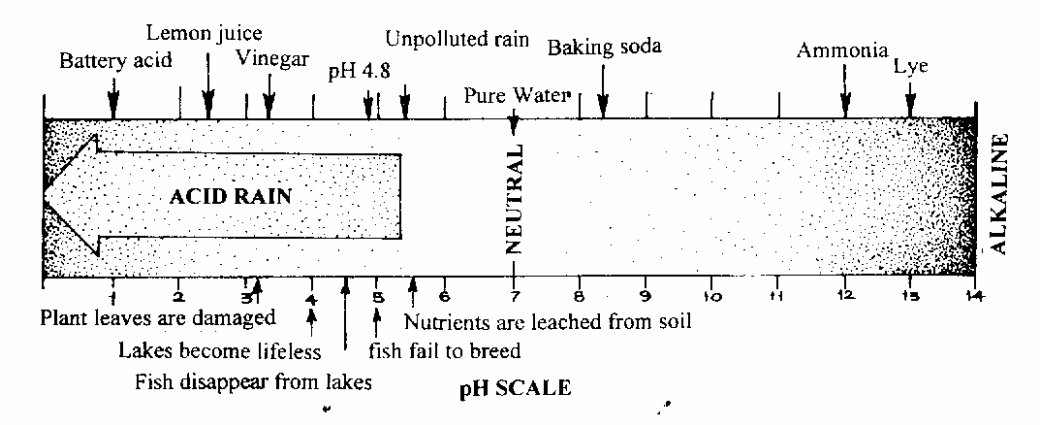
33.4 LOCAL ENVIRONMENTAL ISSUES

This Subsection deals with the environmental impacts that are of localized distribution. The use and misuse of resources by industries and changing lifestyles have resulted in a variety of such problems.

33.4.1 Acidification

The terms `Acidification' or `Acid rain' could startle anyone, if one goes by its literal meaning. This is again a naturally occurring process going on at a very slow pace in the environment, which has got accelerated during the last two decades or so, because of several of the anthropogenic activities. How is acid rain formed? The sulphurous and nitrous gases formed or added to the atmosphere by various means combines with the atmospheric moisture, forming acid which makes the precipitation acidic. Natural rain water is also slightly acidic having a pH of precipitation lowers down to 4.0 or even less when the concentration of these gases becomes higher (Fig. 5). How? The above mentioned two gases constitute a major portion of the emissions of industries and power stations based on fossil fuel combustion. Such areas are the production centres of acid rain which necessarily are not the only receivers. Depending on the prevailing wind directions, these acids can also be carried and deposited hundreds of kilometers from the source area. The most severely affected areas world-wide are: Scandinavia, north Europe, extending to the erstwhile USSR, part of China, North-east USA and eastern Canada. It is feared that with the increase in industrialization and consumption of fossil fuels, more areas many become members of this list.



A pH scale is used to define the levels of acidity or alkalinity. The value 7 on the pH values lower than 7 fall in the acidic range, and values higher than 7 and upto 14 are alkaline.

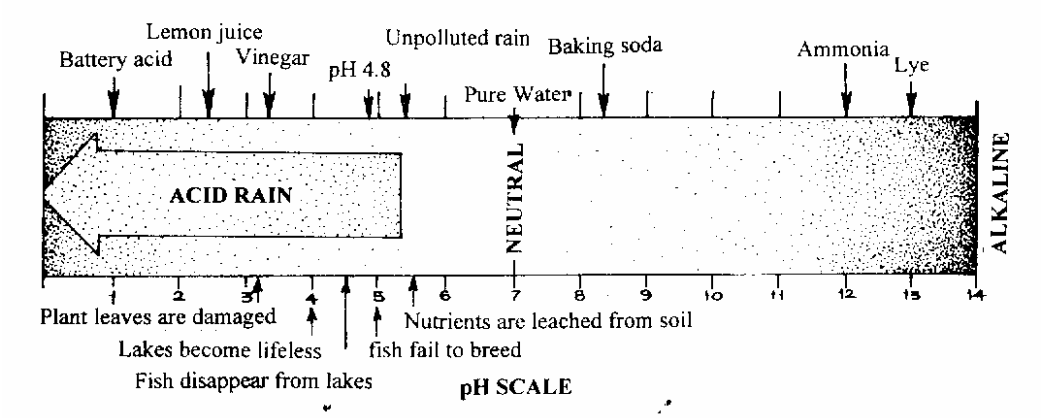


Fig. 5 A pH Scale showing the levels of acidity of different substances. Note the pH range of the acid rain.

Acidification has serious ecological repercussions. It affects both the terrestrial as well as the aquatic ecosystems. Increased acidity sets in a chain of reactions that alter the chemistry of ecosystem altogether. In terrestrial ecosystems acid rain water may either freeze as acidic snow in colder regions, whereas in warmer areas it goes as surface run-off, some part is absorbed by soil and some portion of it percolates down even to the water table. Thus the acid does not remain confined to the soil surface only. It reaches to different soil strata and alters their pH. The foremost effect of a changed pH is shift in the nutrient balance of the soil. Major nutrients required for sustaining various life forms are no more retained by the soil and they get washed off, thus these are not available to the various life forms. This results in degradation of soil quality, damage to the leaves of trees (Fig. 6), constrained vegetative growth of plants, and decay of vegetative parts of extreme cases. All these culminate in loss of vegetation and leave soil vulnerable to erosion.

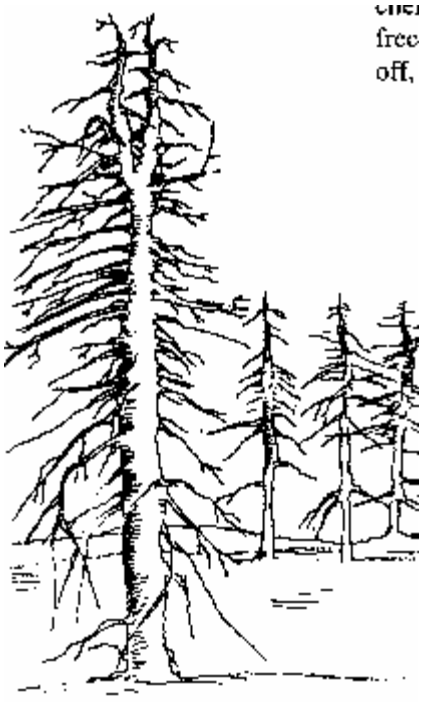


Fig. 6 : A part of a forest showing effects of acid rain. Note the trees are devoid of leaves.

The ecological impacts of acidification are more pronounced in the aquatic ecosystem. The primary changes occur in the nutrient balance that have ramification for plant and animal growth and their reproductive success. The acid tolerant species survive, whereas the less tolerant ones are wiped off, many of which are food sources of different aquatic animals. The stress of inadequate food supply takes its toll on the dependent animals species too. The fish stocks are markedly affected as they are particularly vulnerable when pH is less the 5.0 and also when acidification occurs in rapid pulses.

Can the acidified ecosystems ever recover? If yes, then how? Experiments have shown that liming of lakes can restore the disrupted nutrient balance to some extent. But this is not a long-term solution as its effect is short-lived. The only effective long-term solution is to curb emissions of acid producing gases. This calls for reduction in fossil fuel combustion, and use of alternate energy sources. Another option is to desulphurize fossil fuels for use. This would remove the pollutants before they could reach the atmosphere. Desulphuriation can be easily achieved by the application by biotechnology.

Acidification that has been on the increase since the last two decades is fast affecting larger and larger areas. It has become a source of acrimony between the acid-producing and the `acid-receiving' regions of the world. This necessitated international action and **The Convention on the Long-range Transboundary Air pollution** was signed in November 1979 in Geneva by 35 countries calling for collective action. In **1985** a **new protocol** was signed and the U.K. and USA also joined the earlier signatory countries and agreed to reduce sulphurous emission by atleast 30% of the 1980 levels, by the year 1993. This group is also designated as the 30% club. Some countries like Canada, West Germany, France and Norway agreed to reduce these emissions by 40-50%. In **1988** a **second protocol** was signed for curbing emissions of nitrous gases. These agreements have not merely remained on paper, but have resulted in considerable reduction in these gases. All this is very encouraging!!

33.4.2 Eutrophication

Eutrophication too is a natural phenomenon, which has got accelerated in the last two decades, and has emerged as an important environmental concerns of present times. To distinguish the naturally occurring, slow-paced eutrophication from the one with an accelerated pace due to anthropogenic reasons, the latter is referred to as `**cultural eutrophication'.** Most of our discussion here pertains to `cultural eutrophication'.

Unlike acidification that involves nutrient depletion, eutrophication occurs as a result of nutrient enrichment of the water bodies. The nutrients involved are mainly phosphorus and nitrogen in the forms of phosphates and nitrates. Their chief sources are : urban run-offs, sewage effluents, industrial discharge, drainage from agricultural lands, and also from recreational use of water bodies such as boating.

How does cultural eutrophication affect the water bodies? We shall discuss this in respect of lakes and marine ecosystems. In lakes, it basically stimulates aging process by causing increase in sediment accumulation. Which converts a water body into a terrestrial ecosystem in a matter of few years. For sediment build-up, let us see how the cultural eutrophication affects an ecosystem? The addition of excessive nutrients to a water body by various anthropogenic means makes conditions highly favourable for algal growth. The growth of algae is so rapid that soon the surface of the water body becomes covered with it. This stage is also commonly known as algal bloom. This is quite a common sight and you might have also come across such a situation. Along with the algal growth a large number of bacteria thriving on organic matter too make their appearance in the water body. The profuse bacterial-algal growth has serious implications on the rest of the ecosystem and its inhabitants. Besides enhancing sediment accumulation, the water quality is also degraded. The bacteria utilize a major portion of dissolved oxygen of water to break-down the organic matter present. This creates a biochemical oxygen demand (abbreviated as BOD) in the water. Poor oxygen conditions develop as oxygen is not replaced sufficiently rapidly from the atmosphere. Algal blooms also restrict oxygen replacement in water, especially in the deeper layers. The deficiency of oxygen results in high rate of morality of fish and other aquatic life forms.

Marine water bodies too are not spared of eutrophication. In the sea water near coasts, or in enclosed basins with restricted water exchange, eutrophication is of common occurrence. The nutrient rich waters promote growth of massive algal blooms that consists of diatoms and dinoflagellates (Fig. 7). In extreme circumstances, the massive algal blooms are so prolific that **`red tides'** are created that extend up to 100 kilometers. The `red tides' adversely affect tourism and fishing industry due to noxious odours and poor quantity of dissolved oxygen. Besides these are hazardous to human health too. The shellfish growing in such unhygienic conditions accumulate large amounts of toxins, The consumption of such shellfish often results in nausea, convulsions and even death.

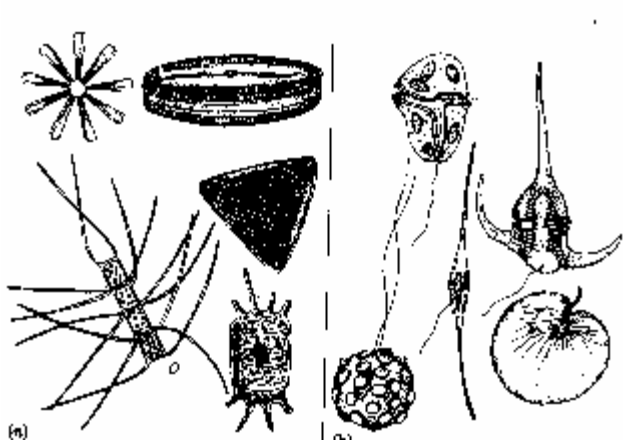


Fig. 7 : Some forms of diatoms (a), and dinoflagellates (b). These microscopic, drifting organisms occur in astronomical numbers in the marine waters. Some of these are also fresh water inhabitants.

Associated with cultural entrophication is another problem, that is, of growth of water hyacinth (*Eichhornia crassipes*). It grows profusely in nutrient rich, fresh water. Their growth is also dense so that most of the surface of the water bodies gets covered (Fig. 8). When it is well established it consumes the oxygen that the fish need to survive, hinders fishing and navigation and stops water flow to a trickle and the hydro-electric power plants become useless. Recently it has come to light that the menacing weeds can be employed as cleaning agents of sewage-ridden water bodies. This is based on the fact that the growing water hyacinths pick up a lot of unwanted nutrients that are present in excessive amounts in the water bodies. The regular harvesting of these plants leaves the waters `purer'. The organic matter of the dried plants can have wide usage such as in energy generation and production of bio-fertilizers. This is a good example of turning a menace into a profitable venture!

Cultural eutrophication, besides damaging the ecosystem is also found to cause serious human health problems, Excessive nitrate build up inside the human body particularly the babies causes "infant methaemoglobinaemia" or "blue baby syndrome". The haemoglobin in such cases cannot perform its usual function of carrying oxygen and in acute cases a blue skin coloration develops: The build up of high nitrogen content is emerging as a major problem in USA and Europe.

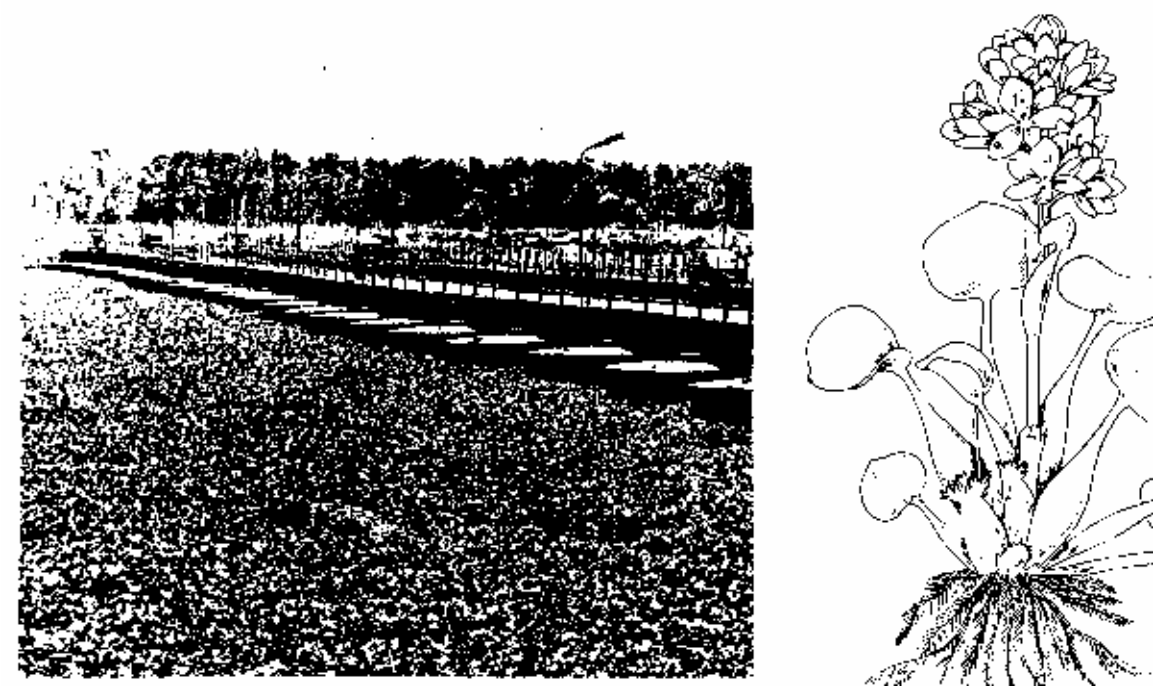


Fig. 8 : Water Hyacinth. a) A portion of river Yamuna in Delhi, the surface is completely covered by this weed. b) Water hyacinth, a flowering plant. It is a floating aquatic plant with profuse rooting. It's paddle-like leaves spread all round the plant. The connecting portions of the leaves, that is, the petioles are swollen into green bladders that makes it very distinct. Its flowers are very attractive. These occur in groups and are violet-blue in colour. Photograph (a) Courtesy : The Hindu.

The extent of cultural eutrophication can be checked and with long-term solutions can also be stopped. One measure, is dilution of nutrient-rich water emanating from various sources before their release. This practice is compulsorily followed in the U.K. Second way is applying certain treatment procedures to sewage to remove phosphorus and nitrogen constituents from it. Third, is voluntary cutback on the use of substances that generate these two nutrients and use of non-pollution causing alternatives for instance non-phosphate detergents, coupled with regulations to limit these in industrial effluents can check this problem to some extent. Further, the voluntary use of natural alternatives instead of the synthetic ones, especially in context of agriculture and households would go a long way to curb this problem.

33.4.3 Desertification

Desertification is defined as land degradation in the arid, semi-arid and dry areas resulting from various factors including climatic changes and human activities. The mere mention of this term conjures up advancing desert engulfing huge chunks of fertile lands. According to estimates by the United Nations Environment Program (UNEP), one-quarter of the Earth's land, or 3.6 billion hectares, is threatened by desertification. The livelihoods of over 1 billion people in more than 100 countries are jeopardized by desertification as farming and grazing land becomes less productive. UNEP estimates that desertification costs the world $42 billions (Rs. 1596 billions) a year. Of the total Africa loses some $9 billions a year, Asia $21 billions, North America $5 billions, Australia and South America $3 billions each and Europe $1 billion.

There is no single cause for desertification. This results mainly in the dry land regions due to the combination of a number of processes. These processes occur naturally and are aggravated under adverse climatic conditions and in areas where population pressures are high. The main causes of desertification are : overgrazing, overcultivation, deforestation, water-logging and salinization of irrigated land. All the above mentioned processes just aid in hastening the degradation of soil quality of areas leading to formation of deserts. What are the remedial measures? These can be categorised as : (I) preventive measures, and; (ii) the restorative measures. The preventive measures involve preserving the soil resource of an area while taking appropriate measures to fulfil the social needs. That is, retaining/regenerating the vegetation destruction due to overgrazing, and for fulfilling various human needs. This target can never be achieved unless alternate arrangements are made for cattle feed and for the various human requirements. Restorative measures include the application of scientific and technical research, in conjunction with the contemporary socio-economic realities. Soil degradation due to overcultivation, water-logging and salinization can now be recovered. It is lot more better to prevent than to cure. Isn't it? A **United Nations Convention** to cope with desertification took effect in December 196. Its official name is the **United Nations Convention to Combat Desertification in Those Countries Experiencing serious Drought and/or Desertification particularly in Africa.**

33.4.4 Pollution : Air, Water, Land

Pollution is defined as an inadvertent/deliberate or accidental contamination of the environment with the wastes generated by various human activities. A large number of these wastes harm vital resources like air, water and soil which ultimately affects the living beings including humans. The contamination of air, water and soil in different parts of the world is of different kinds, and at varying rates. That is to say pollution problems in different locations are different, but their cumulative effects over a period of time have serious global implications. Take the example of air pollution. The localized and differential build up of excessive amounts of dust particles, greenhouse gases, chloro-fluoro-carbons, oxides of sulphur and nitrogen affect the global environment. **Any local environmental issues should not be overlooked or considered trivial because to tackle any global environmental problem, it is essential to attend to the local problems first.** The salient aspects of air pollution are covered under the headings - dust veils, greenhouse effect, ozone depletion and acidification. One more important aspect, that is, of vehicular pollution would be discussed under the heading of `Transportation' shortly.

Likewise soil pollution, commonly referred to land pollution pertains to degradation of this resource in various ways. Notable amongst these being due to deforestation, acidification and desertification - all these have been discussed earlier. Land pollution due to excessive use of fertilizers and pesticides, in the recent years resulted in a number of local environmental problems. Though the role of fertilizers and pesticides was crucial in bringing a **green revolution** in our country, but the environmental problems arising out of it were not foreseen. Not only there has been an accumulation of these agro-chemicls in the soil reaching upto the ground water table, these have also entered the food chain. Recent estimates have shown that the ground water in many areas is so contaminated that it is not fit for human consumption. Higher concentration of agro-chemicals like DDT have been detected in the milk of mothers from such areas. The harmful effects of build up of DDT in human bodies leads to high incidence of cancers. This is one example to show how the effects of pollution can be passed on from one generation to the other. Another important aspect of land pollution results because of the use of soil for dumping all kinds of wastes ranging from organic wastes from diverse sources; plastic, metallic, glass-wastes; and various kinds of chemical and hazardous wastes. Some of these are used as land-fill sites. These again result in leaching out of various toxins to different layers of soils.

The pollution of the third vital resource that is, water, is no less important. Some aspects like acidification, eutrophication and marine pollution have been discussed above. **Thermal pollution** affects the water bodies tremendously. This results due to accumulation of heat in the water body from the discharges of power stations and industries. The sudden shock of high temperatures, or persistence of higher temperatures beyond the tolerance range wipes out many water inhabitants.

Check Your Progress 6

a) Fill in the information pertaining to **acid rain** in the blank spaces given below.

(I) Its forming agents .....

(ii) Its pH range .....

(iii) Contributory production centres .....

(iv) Who are the receivers? .....

(v) Ecological repercussions .....
.....

(vi) Can the affected ecosystems be retrieved?.....
.....

(vii) How?.....

(viii) Any collective action taken? .....
.....

b) Complete the following blank spaces with relevant information concerning **eutrophication.**

i) The kind of ecosystems where it is prevalent.....
.....

ii) The causal agents.....

iii) Sources (of causal agents).....

iv) Its overall effects in an ecosystem.....
.....

v) Suggest remedial measures.....

c) Would you recommend prevention over restoration in the eventuality of **desertification**, or vice-versa? Give reasons.

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d) With the help of an example, discuss the importance of tackling a local environmental problem to combat a global environmental problem.

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33.5 CONTEMPORARY AND EMERGING ENVIRONMENTAL ISSUES

In the discussion above, it has clearly emerged that many of the human activities have resulted in fast degradation of the ecosystem. The pattern and kind of human activities is determined by the life styles of the societies - all have two basic aims- comfortable and secure life. The fruits of beneficial effects, both for the environment and humans may be visible soon, but it's ill-effects on the ecosystem take some time to show up, and to be perceived. In this section we have taken up some such contemporary and emerging environmental issues.

33.5.1 Biotechnology and Genetic Engineering

Human society has employed biotechnology for thousands of years in activities such as brewing, wine-making; bread-making; food-preservation and modification by fermentation, e.g. cheese, vinegar and soy sauce; the manufacture of soap from fats, primitive medication and waste treatment. It is however, the discovery of genetic engineering techniques via recombinant DNA technology which has set in the current not only helped in improving the existing processes and products but have great potential in generating totally new products which were not previously possible. And in context of environment it has a number of actual and potential applications. The environment related aspects of biotechnology are fast developing into a new field of **Environmental Engineering**. It is one of the most exciting and challenging fields of study today. The application of biotechnology to our day to day life has increased tremendously in the recent years. Some of its salient applications are discussed below.

Biotechnology - It is a term that refers to the industrial exploitation of biological systems or processes so as to generate diverse kinds of products to fulfil human needs. It has wide applications in areas like medicine, industry, agriculture, conservation, provision of food, and energy.

Genetic Engineering is a specialized branch of biotechnology that involves manipulation of genetic material of living organisms and these are abbreviated as GMOs.

(i) Waste disposal technology particularly for industrial and sewage effluents largely involve treatment with microorganisms like bacteria and fungi that facilitates quick degradation of wastes liberating harmless products.

(ii) Production of desired end products from wastes, is an offshoot of waste disposal technology. Biological materials, such as sugarcane and cane molasses when degraded by organisms like yeast, result in usable products such as ethanol. This method is vastly employed in Brazil, where ethanol constitutes 30% of all fuel.

(iii) Biomining and resource recycling is another application of biotechnology. Harnessing the ability of certain microorganisms to breakdown mineral ores and mine waters for metal extraction and recovery has positive implications on environmental quality. The organisms that affect metal extraction are termed as **chemolithotrophs**. This method has been successfully employed in extraction of Copper and Uranium. Other metals like Lead, Arsenic, Iron, Silver, Gold, Chromium and Cadmium can also be obtained similarly. Such a method of metal extraction has several advantages over the conventional recovery methods of minerals. For instance, it enables metal extraction from deep-seated ores without large-scale excavation, which is environmentally detrimental. It also aids in effective extraction of metals in pure forms from low-grade ores, as well as mine-wastes.

(iv) The ability of microorganisms to scavenge metals has a number of other applications which includes treatment of waste water. Bacteria such as *Sphaerotilus* natans, extract and accumulated can be subsequently recovered from the bacteria and reused.

(iv) Biotechnology also has applications in the biological control of pests. There are a number of bacteria, fungi and viruses that can produce fatal infections on any plant/animal pests. This method of pest control is environmental friendly that unlike the chemical pesticides, destroys the pests without leaving any harmful residues in the environment. Such a pest control method has recently been discovered to be highly effective for the control of mosquitoes where the microorganisms attack and kill the larvae of mosquitoes. This method is currently being explored for application on a wider scale.

(vi) Certain bacteria known as nitrogen fixing bacteria have the ability to fix atmosphere nitrogen. One example of such bacteria is *Rhizobium* that is associated with leguminous plants. These bacteria have the capacity to convert some of the free atmospheric nitrogen to a usable form for the plant's nitrogen requirements thus avoiding the use of chemical fertilizers and the consequent environmental problems.

Leguminous plants are the members belonging to the family Leguminosae whose modern name is Fabaceae. Some common members of this family are : pea, groundnut and beans.

Talking in specific context of genetic engineering, this technology has been widely applied in the medical field. Well-known products are : interferons -- the anticancer agents, human insulin and many others. In relation to the environment the increasing applications of genetically-engineered organism, also known as the **trangenics**, have raised many concerns and ethical issues. It is widely felt that the genetically engineered organisms may become environmental threat or a threat to public life. The potential use of such organisms in `**biological warfares'** has hit the headlines in most national and international dailies and magazines. All have expressed deep

concern about the possible `biological havoc' these organisms could cause. It would be disastrous if such organisms besides being fatal to the target pests in biological control programmes, are also fatal to other life forms. This would replace/wipe out populations of several species thus causing erosion of the biological diversity and the **gene pool**. In addition many new toxins of these genetically engineered organisms could be added to the environment, the effects of which are hitherto unknown. Many scientists working in this area too have expressed such concerns. For instance, in 1974-75 scientists in USA working in the field of genetic engineering imposed a voluntary moratorium on some aspects of their work. This was done to allow the government to develop requisite safety procedures and guidelines for the use of transgenics. These guidelines have been widely adopted by many nations carrying out such researches. In addition to the guidelines, regulations and moratoria, it is utmost important to have stringent controls, reinforced if necessary by legislation. In out country too, the department of Biotechnology, established by Government of India in 1986 in addition to helping institutions to establish biotechnological infrastructural support, is also keeping strict vigil on the research work of the laboratories engaged in genetic engineering. The **Government of India** has evolved the **`Recombinant DNA Safety Guidelines'** and has notified these under the **Environment (Protection) Act 1986**, for personnel and environmental safety in the use of genetically manipulated organisms in research, manufacture and applications. Besides the various controls, the risks could also be minimised by close cooperation between the industry, government and the regulatory organisations.

The other applications of genetic engineering involving cloning of adult animals, e.g., the recently cloned sheep Dolly and animals that are genetically engineered for organ-transplants to humans have also raised serious issues concerning the society and the environment as a whole. Further research in some of these areas has been banned in many countries.

Clone - A clone is an organism which is genetically identical to the other.

33.5.2 Transportation

Looking at the history of development of human society, the transport factor has played a key role in shaping the growth of various population centres including the cities. In a short span of just about 150 years, from virtually no transport system to the present age of communication, this development perhaps has only a few parallels. Today innumerable modes and varieties of transport are available to reach any near or far place on the globe as well as other planets. Any transport, in general, has two prime requirements.-- energy to drive it, and the physical space for its movement. Several energy sources including steam, fossil fuels and electricity have been deployed to power various transports. Similarly, to facilitate movement on land, in air and on water networks of roads, railway lines, sub-ways, landing strips and harbours were created and developed. From where did all these energy sources come, similarly the space for roads and railway-lines and harbours? From the natural environment itself! Excavation, offshore drillings as well as clearing off of huge tracts of land only destroy the nature, and impinge on the natural habitat of innumerable species residing in those areas. This destruction story does not stop here. The ill, after-effects of use of energy sources and the roads and railway-lines carry the destruction tale further. In the previous sections, you have come across a number of environmental problems arising out of the vehicular use. These are the build up of dust veils, smogs and other forms of atmospheric pollution. With the growing up transport demand, this problem has emerged as a major environmental issue. The air pollution in cities with heavy transport load is such that no citizen can be unaware of this problem. Air pollution levels in Delhi and Calcutta are presently

six times the world Health Organisation (WHO) standards. In certain parts of Delhi they exceed 20 times the WHO level. The results are widely publicised and experienced. The decline in health, rising incidence of respiratory disease and premature deaths in such conditions has promoted us all to pause and think about this fast multiplying problem.

In the present situation. It is difficult to think of a life without various transport means. Especially when places are located in far-flung areas, public transport services are poor, and the pace of life is fast. In view of these constraints the personal transport culture is fast emerging. For it provides comport and convenience at a bearable price. Everyday, yes, everyday hundreds or more cars and scooters are being added to the roads. Similarly, there is all round pressure for increasing air, and water transport services. All boils down to more pressure on the environment. More areas need clearing for building roads and laying rail-lines, and the harmful emissions further load the atmosphere with poisonous gases. What is the solution? Is raising the price of private motoring the answer? or the development of effective, fast-circulating, low-priced public transport system? A decision has to be taken by the regulating agencies as well as by each of the citizen. Those who feel more responsible should come forward spreading awareness such as, the need of keeping vehicular emissions to the minimum by proper maintenance: and the advantages of sharing a vehicle for common destination. In addition, the search for newer, environmental alternative should go on. The newly discovered phenomenon of superconductivity, introduction of unleaded petrol, and the preliminary research findings in the development of unconventional fuels, have shown that all is not dark yet, a ray of hope is still there!

33.5.3 Loss of Biodiversity

Biological diversity, written in short form as biodiversity refers to the total variability among living organisms that inhabit all forms of terrestrial and aquatic habitats of the entire ecosystem. In ecological terms, it includes diversity within species, between species and of ecosystems. Since the last three to four decades, the loss of biodiversity n various quarters of the world has posed serious threat to the global ecology. Thus, it has emerged as a serious environmental concerns of modern times. The causes of loss of biodiversity are manifold. Among these are the rapid expansion of industry and agriculture; urbanization; development projects like dams, highways, mining; increased expansion and intensification of human activities like poaching and trade of wildlife products; and the introduction and promotion of few introduced `High Yielding Varieties' of crops and livestock. all of these have led to the destruction of habitats - the areas with high biodiversity, pollution and over-utilization of biological resources which have resulted in fast depletion of biodiversity. Why is biodiversity important to us and the entire ecosystem? Biodiversity, is not only important for its intrinsic value, but is highly valuable for its ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values. The concern for arresting harm to biodiversity was discussed widely at the **UNCED Earth summit held at Rio De Janerio** in June 1992. This resulted in the signing of the **International Convention on Biological Diversity, CBD**, by 171 signatories. This convention has entered into force from December 29, 1993. It breaks fresh ground in many ways. I acknowledges that genetic resources are no longer to be treated as a common heritage of mankind, but as the sovereign property of the country of origin. It also envisages a reciprocity of arrangements between the developed and developing country parties. the countries of origin with prior information and consent on mutually agreed terms, are expected to make access to these resources. This may be utilized for development of technologies preferably within countries of origin and transfer of technology based on these resources at concessional terms. The value of conservation practices, and knowledge of tribals, herders, peasants and other communities of people who are not part of modern scientific technical establishment - are also acknowledged under this convention. Further,

it calls for mechanisms for sharing the benefits from commercial utilisation of resources they have helped conserve or augment, and of knowledge they have developed.

India, by virtue of the vast variety in physiography and climatic conditions, is blessed with enormous biological diversity, in fact, a **mega-biodiversity**. The number of plant species is estimated to be over 45,000 representing about 7 present of the world's flora. Out of these some 4900 species of flowering plants are endemic to the country. The faunal wealth is equally diverse. The total number of animal species is estimated at 81,000 representing about 6.4 percent of the world's fauna.

Endemic (species)-The species restricted to area or part of the world e.g., Azadirachta Indica is subcontinent.

India is also considered one of the world's 12 **centres of origin of cultivated plants.** Farmers have over centuries developed a rich store o germplasm that includes 51 species of cereals and millets, 104 species of fruits, 27 species of spices and condiments, 55 species of vegetables and pulses, 24 species of fibre crops, 12 species of oil seeds, and various wild strains of tea, coffee, tobacco and sugarcane. Several hundred species of wild crop relatives are distributed all over the country especially in the Western and eastern Himalayas, in the Western Peninsula and the Malabar Coast, North-Eastern India, the Gangetic and the Indus Plains and in the eastern Peninsular area. wild maize relatives occur in the humid and semi-humid tracts of the Eastern and Western Peninsular areas extending to the North-East regions of the country. Wild relatives of wheat and barley have been located in the western and North-Western Himalayas.

Survey Agencies - Surveys of floral and faunal resources in the country are undertaken by the Botanical Survey of India (BSI) established in 1890, and the Zoological Survey of India (ZSI) established in 1916. BSI and ZSI have the headquarters in Calcutta and network of centres located all over India. The forest Survey of India, established in 1981 uses satellite imagery, area photography and ground truth verification to assess forest wealth, in order to develop as accurate database for planning and monitoring.

Likewise, India's ancient practice of domesticating animals has resulted in diverse breeds of livestock, poultry and other animals. This represents a significant percentage of world's diversity. India's eight breeds of buffalo represent the entire range of genetic diversity of buffaloes in the world. Besides there are 26 breeds of cattle. 40 of sheep, 20 goats, 8 of camels, 6 of horses, donkeys and 18 types of poultry. Yak, mithun, geese and ducks have also been domesticated.

For the translation of the International Convention on Biological Diversity provisions into concrete gains, a number of measures have taken by the Ministry of Environment and forests, Government of India. some of these are: conservation of species in their natural habitat, i.e., *in situ conservation* as well as outside their natural habitat, i.e., *ex situ conservation*. `Project Tiger' `Save the Barasingha' campaign and `project on the asiatic elephant' are the species-directed protection efforts.. Under the *ex situ* conservation measures a number of **botanical gardens** and **Zoological parks** have played an important role. The 200 year old **Indian Botanical Garden** in Howrah, West Bengal; and the ones at Bangalore and Lucknow are notable. The **zoological parks** have played important role in species conservation and captive breeding of species such as Manipur Thamin deer, White-winged Wood duck, gharial, turtles and white tiger. In addition, a

network of **Protected Areas** comprising of 85 **National Parks** and 448 Wildlife Sanctuaries covering about 1418, 194 sq km area* in all biogeographic zones of the country, are the measures for wildlife conservation. Under the UNESCO's **Man and Biosphere (MAB) Programme** initiated in 1971, 8 Biosphere Reserves have been set in the country (Table 1) to conserve parts of natural ecosystems in totality.

Table 1 : The Biosphere Reserves of India.

s. no.	*Name of Biosphere Reserve and state*
1	*Nanda Devi -- U.P*
2	*Nokrek -- Meghalaya*
3	*Manas -- Assam*
4	*Sunderbans -- West Bengal*
5	*Gulf of Mannar -- Tamil Nadu*
6	*Nilgiri -- Karnataka, Kerala and Tamil Nadu*
7	*Great Nicobar*
8	*Similipal -- Orissa*

The collection and preservation of genetic resources is done through the National Bureau of Plant Genetic Resources (NBPGR), New Delhi, for wild crop plants; the National Bureau of Animal Genetic Resources (NBAGER), Karnal for domesticated animals; the National Bureau of Fish Genetic Resources (NBFGR), Lucknow for economically valuable fish species.

For effective implementation of Conservation measures the legal and policy framework includes the Forest Act, 1927; **Forest (Conservation) Act 1980; the Wildlife (Protection) Act 1972;** and the umbrella provisions of the Environment (Protection) Act, 1986. These are supported in the different states, by a number of laws and statues related to the management of land, water, forests and other habitats. India is also a signatory to the **Convention on International Trade in Wild Species of Endangered Flora and Fauna (CITES)** to effectively regulate/ban trade in these species.

Despite a policy framework, programmes, legislative support, Non-Government Organizations and a network of extension workers, the problem of dwindling biological resources calls for immediate attention. The implementation of conservation measures needs to strengthened. Shifting responsibilities will be of no consequence. And more and more Conferences and Earth Summits, alone are not going to solve the problem. What ultimately is required is a clear line of action.

The biodiversity concerns need to be integrated into **environmental impact assessment** procedures for all activities, programmes and policies that are likely to have significant effect on the biodiversity, with mandatory participation of those affected by it. The line of action should also look into the problem of **biopiracy** -- that is, free use and exploitation of India's biodiversity resources and knowledge by foreign enterprises. The gaps in legal provision need to be bridged for effective enforcement. And above all, the extent of involvement of each and every citizen understanding his/her role in the ecosystem is the main tool.

Materials33.5.4 Use of Non-degradable

The increasing use of non-degradable materials in the recent years has become a modern trend in the society. Just count how many things are there around you that have their origins in plastics. This in fact is a reflection of the throw-away culture that our society is fast adopting. The good-old tiffin boxes made of metals were there till two decades ago but now a rare specimen of it may be seen. There has been increasing use of fancy items, that are low-priced to suit any one's pocket. The recycled goods are available at still lower prices. Another `good' thing about plastic-ware is, one does not mind discarding it in the waste-bins when one is tired of their use as they are more durable. Similarly, the good old cloth-bags used for carrying groceries and shopping items also seem to have gone. Why should one bother carrying it when plastic carry bags are available. Have you ever thought what happens to these items when these cease to serve us and find their way to the garbage pool and the dumping sites? If you have had a chance to visit such an area, or see any picture of it, all looks very colourful from a distance. On going nearer one finds only plastic and plastic in all hues and colours every where. So much so these fill and block the drainage pipes, and sewage

overflowing the drains create unhygienic conditions. Another growing practice of discarding household wasted in such bags and dumping it anywhere, is being adopted by a large number of city-dweller. It is a common sight to see a large number of such bags in open spaces and even hanging on trees all along the roads. So much so this has become a major environmental problem in areas that surround the favourite tourist spot-Shimla. What are the results of the accumulation of such non-degradable wastes? Even a layman knows, we clean our house and dump filth outside it, but it remains in your, ours and everyone's environment. Isn't it high time to think what are we doing to our ecosystem?

33.5.5 Lead Poisoning

The problem is associated largely with the developed and developing societies. In recent times health problems associated with Lead poisoning are on the rise. Lead finds way into the human body through two channels -- from the atmosphere and drinking waters. Forming a part of vehicular emissions, it originates from the anti-knock agents added to the petrol. Lead is also added to the atmosphere from burning of oil, smelters producing ferrous and non-ferrous metals.

However, natural emissions from volcanoes also produce negligible amounts of the total Lead. And the Lead content in drinking water results as it flows through the Lead pipelines, Lead when absorbed by the blood-stream harms the central nervous system and is particularly likely to cause brain damage in children. Inhalation of toxic fumes of vehicular emissions containing high dosage of Lead, cause toxic Lead encephalitis, i.e., inflammation of the brain, which causes depression, headache and fatigue. The mitigation measures include cut in vehicular and other emissions containing Lead. Use of unleaded petrol in cars has shown marked reduction in the lead content in the ambient air.**

33.5.6 Noise Pollution

Noise pollution is also considered part of air pollution as it travels through the air. But it is a different kind of pollution, that is, it does not accumulate in the environment. Ring a bell or talk to someone, and in a faction of a second he sound is gone. When is sound a noise? In simple terms when the sound becomes unbearably loud it is termed as noise. Noise is defined as any unwanted
.sound(s) of a duration, intensity or other quality that causes some kind of physiological or psychological harms to humans and other living beings.

Sound intensity is measured on a scale of values called Decibel (abbreviated as db) Scale. The softest sound that can be heard by humans is called 0 db. The faintest audible sound has about 10db value. Some common sound intensities are represented on the Decibel Scale in Fig. 9.

Noise causes stress to the human body. The general level of city noise, example, is high enough to deafen us gradually as we grow older. In the absence of noise the hearing ability is generally not deteriorated with advancing age. It is important to know that the most instances of loss of hearing resulting from high environmental noise are not immediately noticeable. One is usually unaware that his hearing ability is losing slowly. Noise pollution is also an occupational health hazards. High intensity noises produced by bulldozers, hammers, heavy vehicles and aircraft are deafening many millions of workers. How does noise affect a human? The first effects are anxiety and stress or in extreme cases, fright. These reactions lead to increased rate of heartbeat constriction of blood vessels, digestive spasms, and dilation of the pupils of the eyes. Psychologists have found that the work efficiency of people goes down as noise levels go up. Three broad kinds of measures can help in combating this problem; one, reduction in origin of noise by proper maintenance of machines/gadgets and other means involved; two, interruption in the path of sound transmission, and; three, protecting the receiver of sound by putting hands over ears or using some protective devices.

** *Annual Report 1995-96 Ministry of Environment and Forests, Government of India.*

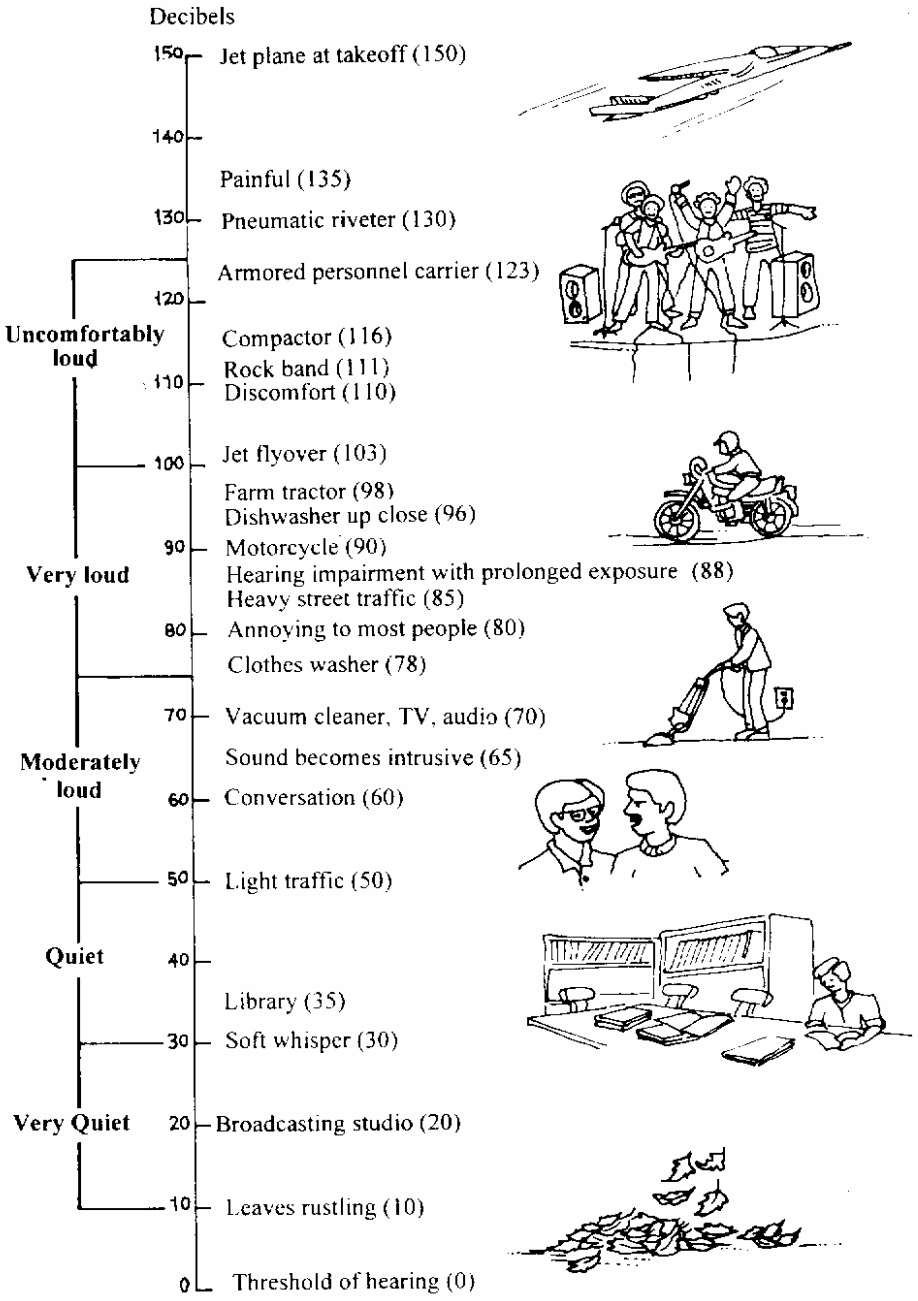

Fig. 9 : A Decibel scale indicating the intensities of some familiar sound sources.

Check your Progress 7

a) Mention a few actual and potential applications of biotechnology.

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b) Which modes of transport are prevalent in your city/village? List them and classify them as environment-friendly and non-friendly.

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c) Have a look around the place where you live, for various naturally occurring life forms. Try to recall if there has been any changes in their distribution in the last five years? If yes, mention giving reasons as to what sort of changes have occurred?

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d) How prevalent have been non-degradable materials in your day to day use? Mention a few examples of articles made of non-degradable materials that you think you can do away with.

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e) How prone is human health to Lead poisoning in your area; represent it with a number of + signs.

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f) Make a list of five most distressing noises that you heard on any particular day. Suggest how can each one he reduced or eliminated?

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33.6 CONSERVATION EFFORTS

The respect and fascination for its natural heritage has been deeply etched in Indian history. the ancient records about the conservation methods adopted are the proofs of this. World's first recorded conservation measures especially for wildlife, were enacted in India during the third century B.C. when **Eemperor Ashok's** benevolence was extended to all living beings. He not only set up hospitals and reserves for wild animals and birds, but implemented various species-specific protection measures. But it was not only the rulers of India who protected and preserved their heritage, common people were also involved in conservation. For example, the followers of **Bishnoi** faith ,also known as Bishnois respect all living beings and emphasize on non-violent way of life. Each and every member of this faith protects wildlife and do not permit felling of trees in their area. There is a well known incidence connected to this. In 1730, the maharaja of jodhpur ordered his men to fetch some wood from a Bishnoi area. Bishnois women and children all gathered at that area and hugged the trees to save them. Over 360 of these women and children were hacked to death in this process by the king's men and they finally had to give up and return empty handed. These principles are being practiced by them till now. This is the reasons that the Bishnoi lands stand apart as oases in the vast deserts of Rajasthan.

In various parts of the country, **sacred groves** exists. These by tradition protect pockets of natural biodiversity. These areas are part of a temple or some sacred region. Thus they have original flora preserved in its natural form. The animal species such as snakes and monkeys inhabiting this area too are considered sacred and worshipped by people. Many such groups occur in the Western Ghats and north-east India.

The famous **Chipko Movement**, active since 1973 in U.P., is known the world over. It is one of the real-life examples showing showing how the collective strength of people can restore environment. Chipko - means `to hug' and it was the principle weapon for the group of protesters to hug trees to prevent them from being felled. It grew out of local opposition to the discriminatory practices of the State Government and the private companies towards the local hill people. Contracts were awarded to large commercial companies for use of timber and resin, while local people were dependent on them for fuel, fodder and other provisions. This movement that started with the aims of protecting trees has now broadened its aims to preserve forest cover, prevent soil erosion and landslides and create forests that can be used in sustainable ways. Women suffered more than men from the destruction of forests. With forests intact fuel wood could be collected from nearby areas, otherwise they had to walk several kilometers to fetch wood. From UP this movement also spread to other parts of the country. A similar movement named **Appiko movement** was launched in the tropical forests of the Western Ghats. It simplicity

and non-violent approach became very popular and a large number of people joined this movement.

Going back to the 1960s, increasing environmental repercussions were perceived by the human society as ominous signs of the brewing crises in the ecosystem and the imminent threat to the survival of human society. By then a gradual shift in the thinking of the society had begun. A shift from the belief that `nature has been made to serve the mankind so it is free to use if in the way it wants' towards the ideology that `humans must live with rather than exploit nature' became clearly visible. People all over the world now realised that **Environment is common** for all and it **has no transnational boundaries**. This was the right. This was the right time for peoples of the world gathered together for environments cause. The **United Nations Conference on Human Environment was held at Stockholm in 1972**, with India taking a lead in it. Mrs. Indira Gandhi, then Prime Minister of India was the only visiting head of the government to attend this UN conference. This conference produced a declaration of Principles, a plan to deal with certain environmental programmes. Following this, **the United Nations Environment Programme (UNEP)** initiated a monitoring system to detect global pollution that might affect the weather and climate.

And back home, at the initiative of Mrs. Indira Gandhi in 1972, a **National Council of Environmental Planning and Coordination (NCEPC)** was set up to identify and investigate the problems of preserving or improving the human environment, and to propose solutions to the various environmental problems in our country. Subsequently, a full-fledged **Ministry of Environment and Forest** was set up in **1985**. It is the apex body under the Government of India for planning, promotion and coordination of environmental and forestry programmes. The **National Wasteland Development Board** and the **Ganga Project Directorate** are major components of the Ministry. Its activities are : survey and conservation of flora and fauna; prevention and control of pollution; afforestation and regeneration of degraded areas; environmental impact assessment; forest conservation and research; environmental information and education.

Twenty years after the Stockholm conference, a **united Nations conference on Environment and Development (UNCED)** also known as the **UNCED Earth Summit** or the **Rio conference** was held at Rio de Janerio, Brazil in 1992. A mention of this has already been made earlier in the Subsection 33.5.3. It was the world's largest ever gathering of leaders to discuss the threat to global ecology. It was also billed as the "**last chance to save the earth."** The much talked about `**Convention on biological diversity'** is the outcome of this conference that entered into force from December 29, 1993. It made legally binding for the signatory countries to bring about legislative, administrative and policy regime regarding biological diversity in tune with the Articles of this convention. After the UN General Assembly proclamation, **29th December** of the year is celebrated as the **International Day for Biological diversity**. It is pertinent to mention here that the 5th of June of every year is celebrated as the **World Environment day**. Five years after the historic Earth summit in Rio de Janerio in 1992, a special session of the General Assembly of the United Nations known as **UNGASS/Rio+5/Earth Summit plus 5**, was held in June, 1997 to review the progress made. This has also ended as an apparent failure as both the developing and the developed nations stuck to their known positions. In the absence of political will, should all hopes be given up? Not yet. There is immense potential power in the willing people, yes, the people of the whole world. Their collective strength can swing the balance of environment from total disaster to prosperity. Three Indian examples, discussed below would prove this point.

Our first example is of the joint protest by the people in a village in Dharwad, Karnataka against the polluting industries. People in this area spearheaded a movement against two synthetic fibre manufacturing units for polluting the Tungabhadra river with coloured effluents. It was largely because of their efforts that the State Pollution Control Board decided in September 1990 to prosecute the two units.

The second example is of quarrying in the Doon valley. It had seriously damaged the scenic beauty of the Mussoorie Hills, and has left barely 12 percent tree over, whereas the recommended cover is 60 percent. In February, 1983, the Government decided to not to renew the quarrying leases. However, the lessees obtained stay orders and resumed mining operations at an increased pace. A number of citizens organisations like the `Rural Litigation and Entitlement Kendra', `Friends of the Doon Society' and the `Save Mussoorie Society' filed a writ petition in the Supreme Court against the quarrying activities. The Supreme Court passed an interim order declaring the closure of mines and also classified these as extremely dangerous. It also ordered a total ban on the use of chemical explosives for extracting limestone.

The third example is of the recent Supreme Court's decision regarding the ban on all aquaculture in mangrove swamps, estuaries, wetlands, and on public land, as well as a prohibition converting agricultural land into shrimp farms. This aspect has been discussed earlier in subsection 33.3.3. also. The point that we wish to make here is that the court has ordered the closure after a long campaign by environmentalist groups. Their protest focused or the repercussions of aquafarming, i.e., the contamination of land and drinking water from the discharge of toxic effluents.

Like in India, a number of environmental organizations and movements are operative at the international arena. The names of **Greenpeace** and **Friends of the Earth** are known world over for their environmental conservation activities. Greenpeace was founded in Vancouver in 1970. This group with their motto of non-violent confrontation initially sought to prevent nuclear testing in the Pacific by sailing right into the danger zone. Similarly, this group also campaigned actively for preservation of whales. Their subsequent conservation activities were extended to protect North Sea, the Great lakes and Antartica. This group has now established over 35 main branches in 22 countries. `**Friends of the Earth'** began in the United States as a splinter group from the noted Sierra Club in `1970 and became involved in a number of environmental issues including the antinuclear movement.

The efforts of individuals have been also as effective in generating environmental awareness in the society as well as implementing conservation measures. One is only but inspired by the persistent efforts and contributions made by social workers and environmentalists like Sunderland Bahuguna, Anna Hazare, M. C. Mehta, Anil Agarwal, Medha Patker, Vandana Shiva and several others. All one needs is the will to act for the environment's cause. This is now Anna Hazare in 1976 after retirement began changing the environmental fortunes of this village was a picture of economic stagnation. Hazare resolved to change things. Realising that water was the key issues, he studied the topography of the village and initiated steps to conserve rain water. Next, he took up the area of soil conservation under the state government's Wasteland Development Programme. Massive tree plantation was taken up, their dogged efforts raised the survival rates of plantations to 90 percent as compared to 50-60 percent in official programmes. Also **Biogas Plants** and **smokeless chulhas** were installed. Today, the village has proved its capability to withstand drought and now it presents a picture of prosperity. This example clearly illustrates that provided the will, it is not impossible to avert ecological crises and retrieve the ecosystem.

Several incentives and awards have been instituted to encourage and promote working for environmental cause. Some notable awards in our country are:

1. Indira Gandhi Parayavaran Puraskar (IGPP),

2. Indira Priyadarshini Vrikshamitra Awards (IVPM),

3. Mahavriksha Puraskar,

4. National Award for Prevention of Polltuion,

5. Pitamber Pant National Environment Fellowship Award, and

6. B. Pal National Environment Fellowship Award for Biodiversity.

How far has the society reached on the road to resolve various ecosystem crises? There has been certain progress which is reflected by the fact that more and more people are becoming aware of the problems, their role in it, and what is expected of them. Consequently **recycled papers and goods,** the appearance of the **ECOMARK label** to environmental-friendly household and other consumer products are the positive indications of the society adopting **Green ways of life.** The progress should not stop here. Still we have a long way to go.

33.7 IN THE FUTURE AHEAD

After looking at the picture of the environment in totality and taking into account the emerging concerns one may wonder, which way to choose? Would a reversion to the practices prevalent two hundred years back is the right choice? Or some other alternatives should be explored. The likely reaction of most people to the first question would be loud No. But why? The very thought of uncertainties and insecurities of life in available then.

The environmental awareness in the recent years has drawn a definite attention of the society. And there is increasing realization that most of these problems have resulted due to wasteful ways of the life that the society has chosen and adopted over the years. It is also becoming clearer that in the continuance of the present trends, not only would the existence of ecosystem be imperilled but the very survival of human race is also threatened. As a result, the appraisal of the existing ways of resource use and their environmental consequence in light of the social realities such as poverty, economic change and developments began. `**Sustainable development'** emerged as its answer. It is a **unifying approach having a blend of environmental, developmental and economic imperatives**. To understand the meaning of the term `sustainable' let us consider an example of a forest. The forest as a resource can be made **productive and environmentally sustainable if it is utilized in a way which works within the limits of the system's capacity to reproduce itself.** The sustainable development approach in the national context has two goals: restoration of past ecological damage and insulation of the country from the damage as a consequence of future development, To achieve these goals both long- as well as short-term policies are to be framed and implemented. The journey to sustainable future looks long and difficult. But remember most difficult journeys start with the first step. The difficult journeys can be more easily undertaken if broken into smaller, less tedious stages. The task is not impossible afterall.

As you begin to untake your journey in this venture always remember that **the whole ecosystem is a unit with innumerable interlinks.** Touch one link. it affects all in some way. Relating this to the environmental problems, **do not view an environmental problem say ozone depletion or increase in greenhouse gases in isolation. There are some causes common for both. Any remedial measures should be holistic.** We should aim not to merely address to the symptoms of the problem, **but attempt to set the whole system right. The measures selected should not protect environment from people, but for the people.** The journey is tough and long. But **clear vision and determination should see us win.**

33.8 LET US SUM UP

In this unit you have studied that:

Life on this planet is confined to the biosphere which extends from the oceanic depths upto a certain height in the atmosphere.

Environment represents a sum total of all the living and non-living factors surrounding an organism.

Ecosystem is an ecological unit of nature. It consists of inter linked species and the physical factors surrounding them.

Over the recent years, our atmosphere has been undergoing rapid changes which are degenerative for not only the living beings beings but the entire life support system. The build up of dust veils, acceleration of greenhouse effect, and ozone destruction are the major contributors in bringing about the change.

Deforestation is a rampant ecological problem, with a series of global consequences. Habitat destruction ,soil becoming vulnerable to the physical forces such as wind and rain thereby causing soil degradation, disturbance of the water balance and the climate, and several kinds of ecological disasters are linked to deforestation.

The oceans and seas that are the common property resources, have been mindlessly exploited for hundreds of years. These have been used for dumping all kinds of wastes; as a source for cheap and bulk transport of goods; meeting food requirements of human society and for recreational purposes . All these have taken a toll of the marine ecosystem.

A variety f energy resources are employed all over the world to meet the high energy demands of the modern world. Seeing the modern trends, the future agenda in the energy sector calls for strategies ensuring continual availability of plenty, cheap and environmental friendly sources of energy .

Population pressure does have a contribution in the degradation of the environment. There exist important differences between the developing and the developed world in the links between population change and environmental damage.

Acidification and eutrophication are environmental problems that have arisen due to non-judicious use of resources, changes life styles, abnormal population growth and distribution.

Interestingly, both of these problems can be arrested, and their earlier effects reversed by adopting certain short-term as well as long-term measures.

Desertification although is a natural process, but is accelerated by adverse climatic conditions and human activities. Many solutions to this problem exist, but their implementation is dependent on many socio-economic factors.

Most forms of the air-, water- and soil-pollution at local level have long-term implications at the global level.

Environmental degradation, increasing pollution levels, release of hazardous wastes and other such problems have resulted in the development of a new field of environmental engineering. It has a number of applications with actual and potential use in environmental improvement. Many recent developments in genetic engineering, besides their positive implications to humans as well as the environment, are being assessed all over the world for the risks and hazards to the human society.

A large number of applications of biotechnology and genetic engineering, increasing transportation, loss of biodiversity, wide-scale use of goods made out of non-degradable materials, Lead poisoning and noise pollution are some of emerging environmental issues.

Conservation efforts at the levels of organizations and individuals, both at national as well as international arenas need to be strengthened further for tangible results.

The concept of sustainable development is intended to provide a framework within which people can begin to develop more sensible ways of organizing global, national and local economic decisions making.

33.9 KEY WORDS

Acid Rain : a condition in which natural precipitation becomes acidic after reacting chemically with pollutants in the air.

Atmosphere : layer of air surrounding the Earth's surface.

Aquaculture : growing and harvesting of fish and shellfish for human use in freshwater ponds, irrigation ditches, and lakes or fenced-in portions of coastal lagoons and estuaries.

Aquatic : pertaining to water.

Aquifer : water-bearing layer of the Earth's crust; water in an aquifer is known as groundwater.

Arid : dry, parched with heat.

Biodegradable : material that can be broken down into simple substances, that is, elements and compounds, by bacteria or other decomposers.

Biodiversity : different species in an ecosystem.

Biomass : total dry weight of all living organisms in a given area.

Biome : a group of ecosystems characterized by similar vegetation and climate, and that are collectively recognizable as a single large community unit, e.g., tropical rainforest, grassland, forest and others.

Biosphere : that part of the Earth and its atmosphere that can support life

Bloom : a rapid and often unpredictable growth of a single species in an ecosystem.

Biotechnology : the use of living organisms, often but not always microbes, in industrial processes; the scientific manipulation of living organisms, at the molecular genetic level, to produce useful products.

Clone : a population of identical cells, generally those containing identical, manipulated genetic material or the recombinant DNA molecules.

Coral reef : shallow area near the coast of a warm tropical or subtropical ocean consisting of Calcium containing material secreted by photosynthesizing red and green algae and small coral animals.

Crust (of the Earth) : solid, outer layer of the Earth.

Cultural Eutrophication : overnourishment of aquatic ecosystems with plant nutrients resulting from human activities such as agriculture, urbanization and industrial discharge.

Dust (Veil) : an airborne substance that consists of solid particles typically having diameters greater than 1 ^ (micron). One micron is equal to 10-6 of a meter; large amount of dust particles form a veil in the atmosphere.

Ecology : the study of the inter-relationship among plants and animals, and the interaction between the living organisms and their physical environment.

Ecosystem : a functional unit of the environment comprising the interactions of all organisms and physical components within a given area.

Environment : all of the external conditions that affect on organisms or

other specified system during its lifetime; everything outside of a specified system.

Environmental degradation : depletion or destruction of natural resource by using it at a faster rate than it is naturally replenished, along with the subsequent production of wastes, that accumulate in the atmosphere.

Eutrophication : enrichment of water by nutrients required for plant growth, often over-enrichment caused by sewage and runoff from fertilized agricultural lands, resulting in excessive bacterial growth and oxygen depletion.

Fossil fuels : buried deposits of decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure of Earth's crust over hundreds of millions of years.

Greenhouse effect : the warming principle of greenhouses in which high energy solar rays enter easily, while less energetic heat weaves are not radiated outward; now especially applied to the analogous effect of increasing atmospheric concentrations of carbon dioxide through the burning of fossil fuels and forests.

Gene pool : total genetic information possessed by a given reproducing population.

Hydrosphere : region that includes all the Earth's moisture as liquid water (oceans, smaller bodies of fresh water, and underground aquifers), frozen water (polar ice caps, floating ice, and frozen upper layer of soil known as permafrost), and small amounts of water vapour in the Earth's atmosphere.

Leaching : process in which various soil components found in upper layers are dissolved and carried to lower layer and in some cases to groundwater.

Lithosphere : region of soil and rock consisting of the Earth's upper surface or crust and the upper portion of the mantle of partially molten rock beneath this crust.

National Parks : lands regulated for the preservation of some natural feature as well as for the educational and recreational needs of the general public.

Ozone layer : layer of gaseous ozone (O3) in the upper atmosphere that protects life on Earth by filtering out harmful ultraviolet radiations from the Sun.

Overgrazing : excessive grazing of grasslands by livestock, and to the point at which it cannot be renewed or is renewed slowly because of damage to the root system.

Pollution : a change in the physical, chemical or biological characteristics of the air, water or soil that can affect the health, survival or activities of human beings and other living organisms in a harmful way.

Runoff : surface water entering rivers, fresh water lakes, or reservoirs from land surfaces.

Sustainable (Earth society) : society based on working with nature by recycling and reusing discarded matter, conserving matter and energy resources by reducing unnecessary waste and use, and building items that are easy to recycle, reuse and repair.

33.10 SOME USEFUL REFERENCES

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33.11 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check your Progress 1

a) atmosphere, lithosphere and hydrosphere

b) ?$_1$ Environment

?$_2$ Light/temperature/water

?$_3$ Carbon/Hydrogen/Nitrogen and others

?$_4$ Any living being/plant/animal/microorganism

Check Your Progress 2

2. a) Environment includes all the living and non-living factors that surround and affect an organism. Habitat refers to the physical site where an organism or a population occurs naturally.

b) 3.

Check Your Progress 3

a) Dust from various activities/sources such as fossil-fuel combustion, deforestation, overgrazing, vehicular exhaust emissions, and various military activities.

b) Carbondioxide, methane, nitrous oxide, chloro-fluoro-carbons.

c) Chloro-fluoro-carbons, bromine.

Check Your Progress 4

a) Hint : Mention both the local and the global consequences, Reference subsection 33.3.2.

b) Reference : Subsection 33.3.3.

Check Your Progress 5

a) Hint : One example is being given below. You may add more examples to this list, and like-wise complete the remaining table.

Biomass fuel	Crop residue	emission of carbon dioxide and other gases	++ relatively clean

b) Hint : Touch upon the population pressures in the developed and the developing world. Reference - Subsection 33.3.5.

Check Your Progress 6

a) i) Sulphurous and nitrous gases

ii) Less than 5.6 (also see Fig. 5)

iii) Industries/Power stations/ and all those involving large scale fossil fuel combustion.

iv) The production centres and the adjoining areas, their extent depend on prevailing wind directions.

v) Mention its effect on the terrestrial and aquatic ecosystems. Reference ubsection 33.4.1.

vi) Yes

vii) Hint: Mention the short-term and long-term measures. Reference Subsection 33.4.1

viii) Hint : Signing of Protocol. Reference Subsection 33.4.1

b) i) Aquatic ecosystems

ii) Excessive amounts of the phosphates and nitrates.

iii) Hints : Runoffs from urban centres and agricultural lands, industrial effluents, sewage, recreational areas. You may add more of this list.

iv) Hint : Check on the activities contributing to nutrient enrichment of water bodies.

c) Write your viewpoint. Reference Subsection 33.4.3.

d) Elaborate any one example. Reference Section 33.4. particularly subsection 33.4.4.

Check Your Progress 7

a) List actual and potential applications under separate heads. Reference Subsection 33.5.1.

b) Write you observations.

c) You can also consult your family members as well as neighbours and friends to ascertain the kind of change in biodiversity in the past five years.

d) Write from your experience.

e) Represent with different number of + signs, e.g., ++++ may be used to denote `highly prone', +++ for `fairly prone', and so on.

f) Note down any five examples on a particular day, and suggest measures for their reduction/elimination.