

*Zero to Mastery in*  
**ENVIRONMENTAL SCIENCE**





# *Zero to Mastery in* **ENVIRONMENTAL SCIENCE**

ARNOLD NEEL

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• Shadab Saifi (*Illustrator*) • Ayaz Uddin (*Editor*)

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AN ISO 9001:2008 CERTIFIED COMPANY

## **VAYU EDUCATION OF INDIA**

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2/25, ANSARI ROAD, DARYAGANJ, NEW DELHI-110 002

PH.: 011-41564440, MOB. 09910115201

E-MAIL: [vei@veiindia.com](mailto:vei@veiindia.com) • WEB: [www.veiindia.com](http://www.veiindia.com)

## Preface

**T**he earth is finite, but it will have to provide food and energy to meet the needs of a doubled world population some times in the twenty first century. Its natural resources, already overtaxed in many areas, will have to sustain a world economy that may be five to ten times longer than the present one. This can not be done if humans continue to pursue current patterns. As people continue their endless quest for new materials, new energy forms and new process, the constraints imposed by depletion of natural resources and the pollution caused by human activities have brought society to crossroad.

Environmental protection is national as well as international responsibility but on other hand common man is equally responsible. As a common man this book is my contribution for the environmental protection, so, I have tried to make this text interesting and readable for the relevant students and teachers. The book contains many more facts and details presented in simplified language that a student either need or should attempt to learn.

In all, the text been suitably divided into thirteen chapters. Brief descriptions of various aspects of environment, pollution, social responsibilities of common people towards the ecosystem and legal aspects of environment.

Every attempt has been made to upda te all chapters by use of tables, charts and diagrammatic presentations.

I shall be grateful to the teachers and students for sending their opinion and suggestions.



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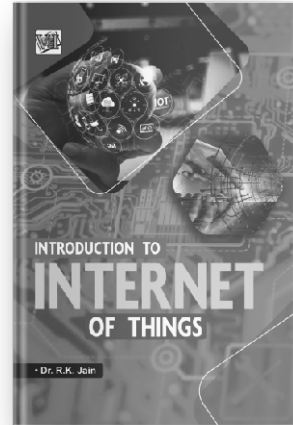
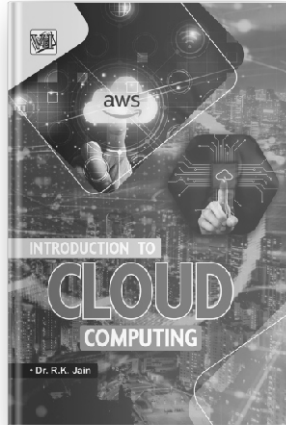
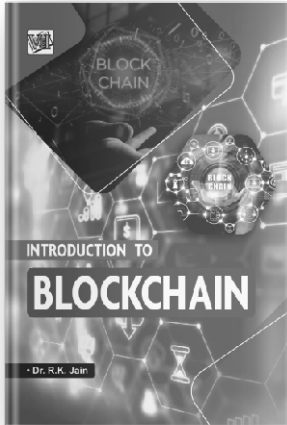
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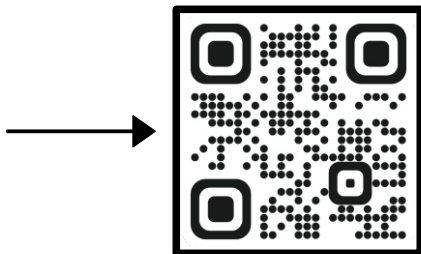
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## CHAPTER

# 1

## Environment and its Importance

The science of Environment studies is a multi-disciplinary science because it comprises various branches of studies like chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering etc. It is the science of physical phenomena in the environment. It studies of the sources, reactions, transport, effect and fate of physical a biological species in the air, water and soil and the effect of from human activity upon these.

### Environment Explained

Literary environment means “the surrounding external conditions influencing development or growth of people, animal or plants; living or working conditions etc”.

This involves three questions:

**(i) What is Surrounded :** The answer to this question is living objects in general and man in particular.

**(ii) By what Surrounded :** The physical attributes are the answer to this question, which become environment. In fact, the concern of all education is the environment of man. However, man cannot exist or be understood in isolation from the other forms of life and from plant life. Hence, environment refers to the sum total of condition, which surrounds point in space and time. The scope of the term Environment has been changing and widening by the passage of time. In the primitive age, the environment consisted of only physical aspects of the planted earth, land, air and water as biological communities. As the time passed on man extended his environment through his social, economic and political functions.

**(iii) Where Surrounded :** The answer to this question. It is in nature that physical component of the plant earth, viz land, air, water etc., support and affect life in the biosphere. According to a Goudie “environment is the representative of physical components of the earth where in man is an important factor affecting the environment”.

## Definitions of Environment

Some important definitions of environment are as under :

**1. According to Boring :** “A person’s environment consists of the sum total of the stimulation which he receives from his conception until his death”,

It can be stated from the above definition that Environment comprises various types of forces such as physical, intellectual, economic, political, cultural, social, moral and emotional. Environment is the sum total of all the external forces, influences and conditions, which affect the life, nature, behavior and the growth, development and maturation of living organisms.

**2. According to Douglas and Holland :** “The term environment is used to describe, in the aggregate, all the external forces, influences and conditions, which affect the life, nature, behavior and the growth, development and maturity of living organisms”,

## Scope of Environment

The environment consists of four segments as under :

**1. Atmosphere :** The atmosphere implies the protective blanket of gases, surrounding the earth:

- (a) It sustains life on the earth.
- (b) It saves it from the hostile environment of outer space.
- (c) It absorbs most of the cosmic rays from outer space and a major portion of the electromagnetic radiation from the sun.
- (d) It transmits only here ultraviolet, visible, near infrared radiation (300 to 2500 nm) and radio waves. (0.14 to 40 m) while filtering out tissue-damaging ultraviolet waves below about 300 nm. The atmosphere is composed of nitrogen and oxygen. Besides, argon, carbon dioxide, and trace gases.

**2. Hydrosphere :** The Hydrosphere comprises all types of water resources oceans, seas, lakes, rivers, streams, reservoir, polar icecaps, glaciers, and ground water.

- (i) Nature 97% of the earth’s water supply is in the oceans,
- (ii) About 2% of the water resources are locked in the polar icecaps and glaciers.
- (iii) Only about 1% is available as fresh surface water-rivers, lakes streams, and ground water fit to be used for human consumption and other uses.

**3. Lithosphere :** Lithosphere is the outer mantle of the solid earth. It consists of minerals occurring in the earth’s crusts and the soil e.g. minerals, organic matter, air and water.

**4. Biosphere :** Biosphere indicates the realm of living organisms and their interactions with environment, viz atmosphere, hydrosphere and lithosphere.

### **Element of Environment**

Environment is constituted by the interacting systems of physical, biological and cultural elements inter-related in various ways, individually as well as collectively. These elements may be explained as under :

**1. Physical elements :** Physical elements are as space, landforms, water bodies, climate soils, rocks and minerals. They determine the variable character of the human habitat, its opportunities as well as limitations.

**2. Biological elements :** Biological elements such as plants, animals, microorganisms and men constitute the biosphere.

**3. Cultural elements :** Cultural elements such as economic, social and political elements are essentially man made features, which make cultural milieu.

### **Importance of Environmental Studies**

**Importance of Environment Studies :** The environment studies enlighten us, about the importance of protection and conservation of our indiscriminate release of pollution into the environment.

At present a great number of environment issues, have grown in size and complexity day by day, threatening the survival of mankind on earth. We study about these issues besides and effective suggestions in the Environment Studies. Environment studies have become significant for the following reasons :

**1. Environment Issues Being of International Importance :** It has been well recognized that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

**2. Problems Cropped in the Wake of Development :** Development, in its wake gave birth to Urbanization, Industrial Growth, Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed world. The North, to cleanse their own environment has, fact fully, managed to move 'dirty' factories of South. When the west developed, it did so perhaps in ignorance of the environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.

**3. Explosively Increase in Pollution :** World census reflects that one in every seven persons in this planted lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

**4. Need for An Alternative Solution :** It is essential, specially for developing countries to find alternative paths to an alternative goal. We need a goal as under :

1. A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.
2. A goal common to all citizens of our earth.
3. A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the “developed” world.

**5. Need to Save Humanity from Extinction :** It is incumbent upon us to save the humanity from extinction. Consequent to our activities constricting the environment and depleting the biosphere, in the name of development.

**6. Need for Wise Planning of Development :** Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to by synchronized with the ecological cycles in any plan of development our actions should be planned ecologically for the sustenance of the environment and development.

**7. Misra’s Report :** Misra (1991) recognized four basic principles of ecology, as under:

- (i) Holism
- (ii) Ecosystem
- (iii) Succession
- (iv) Conversation.

Holism has been considered as the real base of ecology. In hierarchical levels at which interacting units of ecology are discussed, are as under:

Individual < population < community < ecosystem < biome < biosphere

Misra (1991) has recognized four basic requirements of environmental management as under :

- (i) Impact of human activities on the environment,
- (ii) Value system,
- (iii) Plan and design for sustainable development,
- (iv) Environment education.

### **Need for Public Awareness**

It is essential to make the public aware of the formidable consequences of the Environmental Degradation, if not retorted and reformative measures undertaken, would result in the extinction of life. We are facing various environmental challenges. It is essential to get the country acquainted with these challenges so that their acts may be eco-friendly. Some of these challenges are as under:-

**1. Growing Population :** A population of over thousands of millions is growing at 2.11 per cent every year. Over 17 million people are added each year. It puts considerable pressure on its natural resources and reduces the gains of development. Hence, the greatest challenge before us is to limit the population growth. Although population control does automatically lead to development, yet the development leads to a decrease in population growth rates. For this development of the women is essential.



**2. Poverty :** India has often been described a rich land with poor people. The poverty and environmental degradation have a nexus between them. The vast majority of our people are directly dependent on the nature resources of the country for their basic needs of food, fuel shelter and fodder. About 40% of our people are still below the poverty line. Environment degradation has adversely affected the poor who depend upon the resources of their immediate surroundings. Thus, the challenge of poverty and the challenge environment degradation are two facets of the same challenge. The population growth is essentially a function of poverty. Because, to the very poor, every child is an earner and helper and global concerns have little relevance for him.

**3. Agricultural Growth :** The people must be acquainted with the methods to sustain and increase agricultural growth with damaging the environment. High yielding varieties have caused soil salinity and damage to physical structure of soil.

**4. Need to Ground water :** It is essential of rationalizing the use of groundwater. Factors like community wastes, industrial effluents and chemical fertilizers and pesticides have polluted our surface water and affected quality of the groundwater. It is essential to restore the water quality of our rivers and other water bodies as lakes is an important challenge. It so finding our suitable strategies for consecration of water, provision of safe drinking water and keeping water bodies clean which are difficult challenges is essential.

**5. Development and Forests :** Forests serve catchments for the rivers. With increasing demand of water, plan to harness the mighty river through large irrigation projects were made. Certainly, these would submerge forests; displace local people, damage flora and fauna. As such, the dams on the river Narmada, Bhagirathi and elsewhere have become areas of political and scientific debate. Forests in India have been shrinking for several centuries owing to pressures of agriculture and other uses. Vast areas that were once green, stand today as wastelands. These areas are to be brought back under vegetative cover. The tribal communities inhabiting forests respects the trees and birds and animal that gives them sustenance. We must recognize the role of these people in restoring and conserving forests. The modern knowledge and skills of the forest department. should be integrated with the traditional knowledge and experience of the local communities. The strategies for the joint management of forests should be evolved in a well planned way.

**6. Degradation of Land :** At present out of the total 329 mha of land, only 266 mha possess any potential for production. Of this, 143 mha is agricultural land nearly and 85 suffers from varying degrees of soil degradation. Of the remaining 123 mha, 40 are completely unproductive. The remaining 83 mha is classified as forest land, of which over half is denuded to various degrees. Nearly 406 million head of livestock have to be supported on 13 mha, or less than 4 per cent of the land classified as pasture land, most of which is overgrazed. Thus, our of 226 mha, about 175 mha or 66 per cent is degraded to varying degrees. Water and wind erosion causes further degradation of almost 150 mha This degradation is to be avoided.

**7. Reorientation of Institutions :** The people should be roused to orient institutions, attitudes and infrastructures, to suit conditions and needs today. The change has to be brought in keeping in view India's traditions for resources use managements and education etc. Change should be brought in education, in attitudes, in administrative procedures and in institutions. Because it affects way people view technology resources and development.

**8. Reduction of Genetic Diversity :** Proper measures to conserve genetic diversity need to be taken. At present most wild genetic stocks have been disappearing from nature. Wilding including the Asiatic Lion are facing problem of loss of genetic diversity. The protected areas network like sanctuaries, national parks, biosphere reserves are isolating populations. So, they are decreasing changes of one group breeding with another. Remedial steps are to be taken to check decreasing genetic diversity.

**9. Evil Consequences of Urbanization :** Nearly 27 per cent Indians live in urban areas. Urbanization and industrialization has given birth to a great number of environmental problem that need urgent attention. Over 30 percent of urban Indians live in slums. Out of India's 3,245 towns and cities, only 21 have partial or full sewerage and treatment facilities. Hence, coping with rapid urbanization is a major challenge.

**10. Air and water Population :** Majority of our industrial plants are using outdated and population technologies and makeshift facilities devoid of any provision of treating their wastes. A great number of cities and industrial areas that have been identified as the worst in terms of air and water pollution. Acts are enforced in the country, but their implement is not so easy. The reason is their implementation needs great resources, technical expertise, political and social will. Again the people are to be made aware of these rules. Their support is indispensable to implement these rules.

## **Conclusion**

Environment, thin layer of life and life-supports called the biosphere, including the Earth's air, soil, water, and living organisms. The atmosphere that shelters the Earth from excessive amounts of ultraviolet radiation and enables life to exist is a gaseous mixture of nitrogen, oxygen, hydrogen, carbon dioxide, water vapour, other elements and compounds, and dust particles. Heated by the Sun and by radiant energy from the Earth, the atmosphere circulates about the planet and modifies temperature differences. Of the Earth's water, 97 per cent makes up the oceans, 2 per cent is ice, and 1 per cent is the fresh water in rivers, lakes, groundwater, and atmospheric and soil moisture. The soil is the thin mantle of material that supports terrestrial life. It is the product of climate, parent material such as glacial till and sedimentary rocks, and vegetation. Dependent on all these are the Earth's living organisms, including human beings.

### **SHORT ANSWER**

1. Define environments.
2. Discuss the scope of environment.
3. Write a note on the importance of environment studies.
4. Write a note on the need of public awareness about environment.
5. Write a note on physical environment.
6. Write a note on biological environment.
7. Discuss the Misra's report and its relevance.
8. Write note on the "atmosphere".
9. What is Hydrosphere and how it's important for environment?
10. How the growing population is effecting on environment?

### **LONG ANSWER**

1. What is Environment? Discuss the scope of Environment.
2. Describe the importance of environment studies.
3. "The need for public awareness about environment is of vital importance." Discuss.
4. Discuss the various types of environment.
5. Write note on lithosphere.
6. What is biosphere, discuss its importance?
7. Discuss the elements of environment.
8. Give the various definitions of environment with interpretation.
9. How poverty can affect the health of environment?
10. Give the reasons of reduction of genetic diversity?

### **TRUE/FALSE**

1. Atmosphere sustains life on earth.
2. All type of water resources are known as lithosphere.
3. About 7% of water resources are locked in polar glaciers.
4. India has 4251 town and cities.
5. Lithosphere is not a part of environment.
6. Solar energy is converted into food energy by organism.
7. Man is carnivorous consumer.
8. Child is the main component of environment.
9. Lion is omnivorous consumer.
10. Total environment is studied in geography.

**FILL IN THE BLANKS**

1. Nature \_\_\_\_\_ % of the earth's water supply is in the ocean.
2. Misra's re[port was released in year \_\_\_\_\_.
3. Every year \_\_\_\_\_ million people are added in world's population.
4. At present \_\_\_\_\_ mha land possess the potential of production.
5. Nearly \_\_\_\_\_ % Indians live in urban areas.
6. conservation is the management of human use of \_\_\_\_\_.
7. Human serves as reservoir of \_\_\_\_\_.
8. environmental awareness provides \_\_\_\_\_.
9. \_\_\_\_\_ is the main polluting agent of the environment.
10. Oxidation of methane produce \_\_\_\_\_.

## CHAPTER

# 2

## Effect of Human Activities on Environment

The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 to study the risk of climate change due to human activities. In the Kyoto Protocol of 1997, industrialized nations agreed to cut down their emissions of greenhouse gases considerably by 2012. Even the G8 committee that began as a response to the 1937 oil crisis and was primarily concerned with the economic issues of the member nations, now unfailingly have something related to the environment in their summits.

Years of thoughtless exploitation of nature by man has resulted in the effects staring right in our face now. The truth, that in the bid to improve our lives, we have put our own survival to stake, has finally hit us hard. Now as more and more studies and researches are being carried out to understand how do humans affect the environment, an increasing number of people are awakening to the fact that the well-being of the environment and survival are intricately woven into each other.

Concisely, not all of them but few effects of human activities can be discussed by following :

### **Environmental impact of agricultural sector**

The recent intensification of agriculture, and the prospects of future intensification, will have major detrimental impacts on the nonagricultural terrestrial and aquatic ecosystems of the world. The doubling of agricultural food production during the past 35 years was associated with a 6.87-fold increase in nitrogen fertilization, a 3.48-fold increase in phosphorus fertilization, a 1.68-fold increase in the amount of irrigated cropland, and a 1.1-fold increase in land in cultivation. Based on a simple linear extension of past trends, the anticipated next doubling of global food production would be associated with approximately 3-fold increases in nitrogen and phosphorus fertilization rates, a doubling of the irrigated land area, and an 18% increase in cropland. These projected changes would have dramatic impacts on the diversity, composition, and functioning of the remaining natural ecosystems of the world, and on their ability to provide society with a variety of essential ecosystem services. The largest impacts would be on freshwater and

marine ecosystems, which would be greatly eutrophied by high rates of nitrogen and phosphorus release from agricultural fields. Aquatic nutrient eutrophication can lead to loss of biodiversity, outbreaks of nuisance species, shifts in the structure of food chains, and impairment of fisheries. Because of aerial redistribution of various forms of nitrogen, agricultural intensification also would eutrophy many natural terrestrial ecosystems and contribute to atmospheric accumulation of greenhouse gases.

**Agriculture has a lot of effects, on the environment :**

**Trees are removed to create fields (Deforestation) :** This is the first problem. Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a nonforest use.

Deforestation is a contributor to global warming, and is often cited as one of the major causes of the enhanced greenhouse effect. Tropical deforestation is responsible for approximately 20% of world greenhouse gas emissions. According to the Intergovernmental Panel on Climate Change deforestation, mainly in tropical areas, could account for up to one-third of total anthropogenic carbon dioxide emissions. But recent calculations suggest that carbon dioxide emissions from deforestation and forest degradation contribute about 12% of total anthropogenic carbon dioxide emissions with a range from 6 to 17%.

**Continuous cultivation of single crop (mono-cropping) :** One singular crop will lead to nutrient deficient soil. They need to be rotated to ensure that the minerals stay in the ground. In the absence of crop rotation long-term improvement of soil quality and productivity decreases. Continuous cultivation of same crops (and manure) on the same piece of land over a number of years typically is associated with reduction of soil organic matter, soil structure and aggregation.

**Lots of water is needed for irrigation :** Very often, groundwater is used for irrigation. In many regions, more groundwater is pumped than is naturally replenished. As a result, the groundwater levels drop and the cost of lifting the water becomes more and more expensive. Population groups who used to make modest use of the groundwater are being deprived of this resource and are left in a state of misery. One of the most common negative side-effects of irrigation is soil degradation through waterlogging and salinity. These problems are the cause of reduced yields, loss of land, and a higher incidence of water-borne diseases like malaria, bilharzias, filariasis (WHO 1983).

**Use of fertilizers :** Agriculture uses lots of fertilizers. These may cause problems if they enter a water supply (algal blooms, etc.). In recent years concern has grown over the contribution of nitrogen (N) fertilizers to the environmental problems of nitrate pollution of waters and the pollution of the atmosphere with nitrous oxide, other oxides of nitrogen, and ammonia. These gases potentially contribute to the greenhouse effect or global heating because of their increasing concentrations in the atmosphere and to the destruction of the stratospheric ozone layer, which protects the earth from ultraviolet radiation. In light of these concerns, proposals to mitigate these problems have been considered, and others will be forthcoming. When they have been used in high amounts,

fertilizers and animal manures have created problems of nitrate pollution. Nitrous oxide ( $\text{N}_2\text{O}$ ) is a greenhouse gas and may also contribute to the destruction of the stratospheric ozone when it is converted to nitric oxide.  $\text{N}_2\text{O}$  is primarily produced in the biological processes of nitrification and denitrification. Nitric oxide and nitrogen dioxide are also produced in biological processes and are important in atmospheric reactions in the troposphere and stratosphere. There is little indication that N fertilizers contribute very much to the production of nitrous oxide.

The rate of agriculture will only continue to increase as the population of the earth does, because we will need to feed more and more people.

### **Environmental Impact of Mining**

A variety of environmental impacts may occur at an abandoned mine site. The following describe each of these environmental impacts characteristic of mine sites requiring remediation :

#### **Acid Drainage**

The formation of acid drainage and the contaminants associated with it has been described as the largest environmental problem facing the mining industry. Commonly referred to as acid rock drainage (ARD) or acid mine drainage (AMD), acid drainage may be generated from mine waste rock or tailings (i.e., ARD) or mine structures, such as pits and underground workings (i.e., AMD). Acid generation can occur rapidly, or it may take years or decades to appear and reach its full potential. For that reason, even a long-abandoned site can intensify in regard to its environmental impacts.

The severity of, and impacts from, AMD/ARD are primarily a function of the mineralogy of the rock material and the availability of water and oxygen. While acid may be neutralized by the receiving water, some dissolved metals may remain in solution. Dissolved metals in acid drainage may include lead, copper, silver, manganese, cadmium, iron, and zinc, among other metals. Elevated concentrations of these metals in surface water and ground water can preclude their use as drinking water or aquatic habitat.

#### **Metal Contamination of Ground and Surface Water, and Associated Sediments**

Mining operations can affect ground water quality in several ways. The most obvious occurs in mining below the water table, either in underground workings or open pits. This provides a direct conduit to aquifers. Ground water quality is also affected when waters (natural or process waters or wastewaters) infiltrate through surface materials (including overlying wastes or other material) into ground water. Contamination can also occur when there is an hydraulic connection between surface and ground water. Any of these can cause elevated pollutant levels in ground water. Further, disturbance in the ground water flow regime may affect the quantities of water available for other local uses. In addition, contaminated ground water may discharge to surface water down gradient of the mine, as contributions to base flow in a stream channel or springs.

Dissolved pollutants at a mine site are primarily metals but may include sulfates, nitrates, and radionuclides; these contaminants, once dissolved, can migrate from mining operations to local ground and surface water.

### **Sedimentation of Surface Waters**

Because of the large land area disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion is a primary concern at mine sites. Erosion may cause significant loading of sediments and any entrained chemical pollutants to nearby streams, especially during severe storm events and high snowmelt periods. Historic mining and mineral processing sites may have discharged wastes directly into surface waters. This has been particularly the case with tailings, that historically in many areas were deposited directly into surface waters or placed at the edge of surface waters where erosions would transport the tailings to the surface waters.

### **Environmental Impacts of Industry and Human Housing**

The Industry and Residential colonies not only consume the most energy of all sectors and create the most CO<sub>2</sub> emissions, they also create the most waste, use most non-energy related resources, and are responsible for the most pollution.

### **Climate Change**

Buildings contribute about 50% of CO<sub>2</sub> emissions and construction contributes about another 7%. The authorities have shown that the Government figures on energy performance of houses grossly underestimate the CO<sub>2</sub> gains that could be made by building energy efficient buildings. The main base performance criteria for energy efficient buildings all concern the thermal performance of the building shell where most of the CO<sub>2</sub> gains can be most easily made.

The fact is that if we are serious about climate change then we need to stop playing games with technologies which do not deliver real CO<sub>2</sub> savings. The real challenge in this area is the refurbishment of existing buildings. However it would help for a start, if we also produced really energy efficient new buildings.

### **Waste**

According to agencies the waste going to landfill from the construction industry in 2004 was about 100 million tonnes. This is more than 3 times the amount of domestic waste collection (28 million tonnes). It has gone up from about 70 million tonnes in 2000. In many situations this is equivalent to one house being buried in the ground for every 3 built. This is an important consideration when the embodied energy of a building is being calculated. Usually such calculations do not take into account an extra 25% energy for waste. This is obviously more serious for higher embodied energy products than low embodied energy products.

There are increasing regulations about waste disposal from construction and many



products, even common products like gypsum plasterboard and mineral wool insulation are now labelled as hazardous and require special disposal. In addition there are many projects to find new uses for waste construction materials. However here, as with waste disposal, the less processed a material is, and the less hazardous, the easier re-use, recycling or healthy disposal (for example through composting) will be.

### **Resource Use**

The industries are the major consumer of resources of earth. It accounts for 90% of all non-fuel mineral use, and a large proportion of timber use.

As Bio-Regional and the World Wide Fund for Nature have shown in their One Planet Living material, if everyone in the world consumed resources at the same rate it would take the equivalent of 3 planets now to sustain this consumption. As a global community we exceeded sustainable levels of consumption in the mid 1980s, so both from the point of view of human survival and of justice and equity, it is not feasible or desirable to continue at current levels of consumption.

A distinction needs to be made between sustainable and non- sustainable resources. Sustainable can be divided into renewable resources and plentiful resources. In addition materials which can be indefinitely re-used (or recycled easily) are to some extent sustainable. Non-sustainable resources are those of which there is a known limited supply, and which cannot be replaced or easily reused or recycled with minimal extra energy input. These non-sustainable resources therefore include many minerals, oil and some timber (which is very slow growing or where the extraction causes the extinction of the habitat and therefore of the resource) at our current levels and forms of use. Industries are the main consumer of non-renewable resources, as well as a huge consumer of renewable resources, and this means it must bear greatest responsibility for addressing this situation, and addressing it quickly.

### **Habitat Destruction**

While the three greatest and most imminent threats to the survival of our civilisation are global warming, peak oil (the growing energy gap between supply and demand) and resource depletion, habitat destruction can have a more immediate and disastrous effect on certain localised areas and species. Sometimes these can also have a global impact (for example the impact of the deforestation of the Amazon rain forests).

It is hard to keep track of the number of species made extinct every year, and of the further erosion of biodiverse and rare habitats. However the fact that the industries are such a huge consumer of materials, particularly of imported chemicals, minerals, metals and organic materials such as timber, inevitably means it has a huge impact and obviously has the greatest impact, on habitat erosion and destruction globally.

### **Pollution**

Finally the environmental impact of industries and human house is also felt in terms of

pollution. This is not in the extraction but in the processing of materials. And again, not surprisingly, the industry has the biggest effect of all sector because of the quantity of materials used in it.

As with habitat destruction, it is difficult to track this or control it. Assessments like BREEAM attempt to assess this effect but there is a huge lack of data and resource for doing it across all product lines. What we can do is reduce high energy material use, and use local and low energy materials as much as possible. Until there is proper global control of polluting processes or a clear legislation/ incentives, with proper assessment lifecycle assessment of all materials and manufacturers, we will have to stick to what we are sure of, and also what is inherently non-polluting.

### **Environmental Impacts of Transportation**

The issue of transportation and the environment is paradoxical in nature. From one side, transportation activities support increasing mobility demands for passengers and freight, and this ranging from urban areas to international trade. On the other side, transport activities have resulted in growing levels of motorization and congestion. As a result, the transportation sector is becoming increasingly **linked to environmental problems**. With a technology relying heavily on the combustion of hydrocarbons, notably with the internal combustion engine, the impacts of transportation over environmental systems has increased with motorization. This has reached a point where transportation activities are a dominant factor behind the emission of most pollutants and thus their impacts on the environment. These impacts, like all environmental impacts, can fall within three categories:

**Direct impacts :** The immediate consequence of transport activities on the environment where the cause and effect relationship is generally clear and well understood.

**Indirect impacts :** The secondary (or tertiary) effects of transport activities on environmental systems. They are often of higher consequence than direct impacts, but the involved relationships are often misunderstood and difficult to establish.

**Cumulative impacts :** The additive, multiplicative or synergetic consequences of transport activities. They take into account of the varied effects of direct and indirect impacts on an ecosystem, which are often unpredicted.

Transportation activities support increasing mobility demands for passengers and freight, notably in urban areas. But transport activities have resulted in growing levels of motorization and congestion. The most important impacts of transport on the environment relate to climate change, air quality, noise, water quality, soil quality, biodiversity and land take:

**Climate change :** The activities of the transport industry release several million tons of gases each year into the atmosphere. These include lead (Pb), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>; not a pollutant), methane (CH<sub>4</sub>), nitrogen oxides (NO<sub>x</sub>), nitrous

oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs), perfluorocarbons (PFCs), silicon tetrafluoride (SF<sub>6</sub>), benzene and volatile components (BTX), heavy metals (zinc, chrome, copper and cadmium) and particulate matters (ash, dust).

**Air quality :** Highway vehicles, marine engines, locomotives and aircraft are the sources of pollution in the form of gas and particulate matters emissions that affects air quality causing damage to human health. Toxic air pollutants are associated with cancer, cardiovascular, respiratory and neurological diseases. Carbon monoxide (CO) when inhaled affects bloodstream, reduces the availability of oxygen and can be extremely harmful to public health. An emission of nitrogen dioxide (NO<sub>2</sub>) from transportation sources reduces lung function, affects the respiratory immune defense system and increases the risk of respiratory problems. The emissions of sulphur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) in the atmosphere form various acidic compounds that when mixed in cloud water creates acid rain.

**Noise :** Noise represents the general effect of irregular and chaotic sounds. It is traumatizing for the hearing organ and that may affect the quality of life by its unpleasant and disturbing character. Long term exposure to noise levels above 75dB seriously hampers hearing and affects human physical and psychological wellbeing. Transport noise emanating from the movement of transport vehicles and the operations of ports, airports and railyards affects human health, through an increase in the risk of cardiovascular diseases. Increasing noise levels have a negative impact on the urban environment reflected in falling land values and loss of productive land uses.

**Water quality :** Transport activities have an impact on hydrological conditions. Fuel, chemical and other hazardous particulates discarded from aircraft, cars, trucks and trains or from port and airport terminal operations, such as de-icing, can contaminate rivers, lakes, wetlands and oceans. Because demand for shipping services is increasing, marine transport emissions represent the most important segment of water quality inventory of the transportation sector. The main effects of marine transport operations on water quality predominantly arise from dredging, waste, ballast waters and oil spills.

**Soil quality :** The environmental impact of transportation on soil consists of soil erosion and soil contamination. Coastal transport facilities have significant impacts on soil erosion. Shipping activities are modifying the scale and scope of wave actions leading to serious damage in confined channels such as river banks. The removal of earth's surface for highway construction or lessening surface grades for port and airport developments have led to important loss of fertile and productive soils. Soil contamination can occur through the use of toxic materials by the transport industry.

**Biodiversity :** Transportation also influences natural vegetation. The need for construction materials and the development of land-based transportation has led to deforestation. Many transport routes have required draining land, thus reducing wetland areas and driving-out water plant species. The need to maintain road and rail right-of-

way or to stabilize slope along transport facilities has resulted in restricting growth of certain plants or has produced changes in plants with the introduction of new species different from those which originally grew in the areas. Many animal species are becoming extinct as a result of changes in their natural habitats and reduction of ranges.

### **Conclusion**

The impact of human activities on the environment Everything that humans do has some impact on the environment. Pollution is a result of human activities in the environment. The main sources of pollution are Agriculture, transportation and Housing. Farming is having an increased impact on the environment. This is because there is increased pressure on farmers to produce a single crop and to concentrate on one form of animal husbandry, such as, dairy cattle or pig breeding.

### **LONG ANSWER**

1. Discuss the impacts of agriculture on environment.
2. Discuss the impacts of mining on environment.
3. Discuss the impacts of industry on environment.
4. Discuss the impacts of housing on environment.
5. How the excess use of fertilizer is lethal to environment?
6. How the industries causing the climate change?
7. How the transportation cause the climate change?
8. How transportation destroy biodiversity?
9. How the effect of mining can be minimized?
10. Discuss the relationship of transportation & noise pollution.

### **SHORT ANSWER**

1. Write notes on deforestation.
2. Write notes on Mono-cropping.
3. What are the Impacts of irrigation on ground water level?
4. Write notes on acid drainage.
5. Write notes on sedimentation of surface water.
6. How habitat destruction takes place?
7. Discuss the environmental impacts of transportation.
8. How transportation effect soil quality?
9. Discuss the remedies of impact of human activities.
10. How mines contaminate the ground water?

**FILL IN THE BLANKS**

1. Deforestation cause \_\_\_\_\_% of CO<sub>2</sub> emissions.
2. \_\_\_\_\_ is the side affect of irrigation.
3. N<sub>2</sub>O is a \_\_\_\_\_ gas.
4. Building produce \_\_\_\_\_% of CO<sub>2</sub> emissions.
5. In 2004 waste production by industries was \_\_\_\_\_million tones.
6. Industries use \_\_\_\_\_ % of all non-fuel minerals.
7. Transportation release heavy metals such as \_\_\_\_\_, \_\_\_\_\_ & \_\_\_\_\_.
8. Long exposure of noise level above \_\_\_\_\_ is dangerous.
9. Immediate consequences of transportation are known as \_\_\_\_\_ impacts.
10. CFC's stands for \_\_\_\_\_.

**TRUE/FALSE**

1. ARD is concern with agricultural sector.
2. Noise pollution can cause cardiovascular disease.
3. Silicon tetra-fluoride causes climate change.
4. CO can reduce the oxygen level in the blood.
5. NO<sub>2</sub> effect negatively on immune system of body.
6. Lead has no direct impact on climate change.
7. ARD produce more acid than AMD.
8. Malaria and filariasis are water borne diseases.
9. Domestic waste production of India is 31 million tones/year.
10. Transportation has no impact on soil quality.

## CHAPTER

# 3

## Sustainable Development and EIA

According to Norwegian prime minister Gro Harlem Brundtland, in 1987 :

“Sustainable development is development which meets the needs of the present without compromising the ability of future generation to meet their own needs.”

The word development in this definition implicates two important aspects of the concept:

It is omni-disciplinary, it cannot be limited to a number of disciplines or areas, but it is applicable to the whole world and everyone and everything on it, now and in the future. Secondly, there is no set aim, but the continuation of development is the aim of the development. The definition is based on two concepts:

- the concept of needs, comprising of the conditions for maintaining an acceptable life standard for all people, and
- the concept of limits of the capacity of the environment to fulfill the needs of the present and the future, determined by the state of technology and social organization.

**The Needs :** The needs consist firstly of basic needs such as food, clothing, housing and employment. Secondly, every individual, in every part of the world should have the opportunity to try and raise his or her life standard above this absolute minimum.

**The Limits :** The limits consist of natural limitations like finite resources, but also of declining productivity caused by overexploitation of resources, declining quality of water and shrinking of biodiversity. For our common future, it would therefore be best if needs are best fulfilled while limits are not increased, but preferably decreased. This would lead to the quite simple conclusion that all political, technical and social developments can easily be evaluated in the light of sustainable development by these two arguments. Any development should help fulfill needs and should not increase limitations.

**Three dimensions of environmental sustainability:** A complete and effective sustainable development is mixture of three dimensions:

1. Environmental sustainability
2. Social sustainability
3. Economic sustainability

### 1. Environmental dimensions of sustainability

- Reduced waste, effluent generation, emissions to environment
- Reduced impact on human health
- Use of renewable raw materials
- Elimination of toxic substances

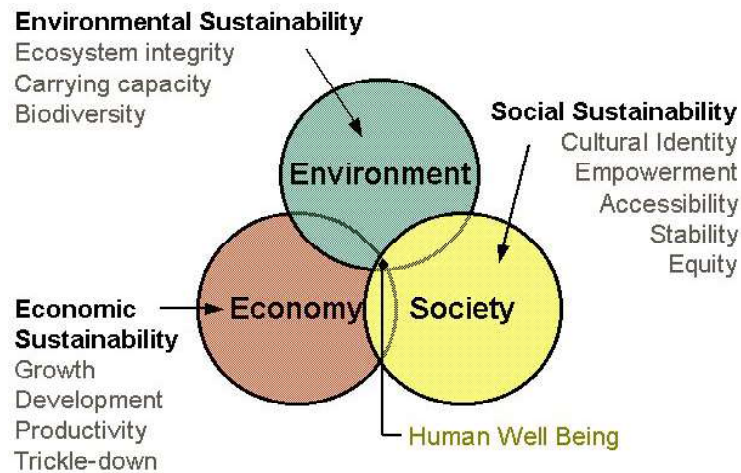


Fig. 3.1. Three dimensions of the sustainability

### 2. Social dimensions of sustainability

- Worker health and safety
- Impacts on local communities, quality of life
- Benefits to disadvantaged groups

### 3. Economic dimensions of sustainability

- Creation of new markets and opportunities for sales growth
- Cost reduction through efficiency improvements and reduced energy and raw material inputs
- Creation of additional added value

### How to achieve Environmental Sustainability

The idea of environmental sustainability is to leave the Earth in as good or better shape for future generations than we found it for ourselves.

By a definition, human activity is only environmentally sustainable when it can be performed or maintained indefinitely without depleting natural resources or degrading the natural environment.

- Resource consumption would be minimal
- Materials consumed would be made ENTIRELY of 100% post-consumer recycled materials or from renewable resources (which were harvested without harm to the environment and without depletion of the resource base)
- Recycling of waste streams would be 100%
- Energy would be conserved and energy supplies would be ENTIRELY renewable and non-polluting (solar thermal and electric, wind power, biomass, etc.)

### **Sustainable Construction**

Sustainable construction is defined as :

“The creation and responsible management of a healthy built environment based on resource efficient and ecological principles”.

Sustainable designed buildings aim to lessen their impact on our environment through energy and resource efficiency.

It includes the following principles:

- minimizing non-renewable resource consumption
- enhancing the natural environment
- eliminating or minimizing the use of toxins

Environmental Architecture

Five principles of an environmental architecture:-

• **Healthful Interior Environment** : All possible measures are to be taken to ensure that materials and building systems do not emit toxic substances and gasses into the interior atmosphere. Additional measures are to be taken to clean and revitalize interior air with filtration and plantings.

• **Energy Efficiency** : All possible measures are to be taken to ensure that the building's use of energy is minimal. Cooling, heating and lighting systems are to use methods and products that conserve or eliminate energy use.

• **Ecologically Benign Materials** : All possible measures are to be taken to use building materials and products that minimize destruction of the global environment. Wood is to be selected based on non destructive forestry practices. Other materials and products are to be considered based on the toxic waste out put of production.

• **Environmental Form** : All possible measures are to be taken to relate the form and plan of the design to the site, the region and the climate. Measures are to be taken to “heal” and augment the ecology of the site. Accommodations are to be made for recycling and energy efficiency. Measures are to be taken to relate the form of building to a harmonious relationship between the inhabitants and nature.



- **Good Design** : All possible measures are to be taken to achieve an efficient, long lasting and elegant relationship of use areas, circulation, building form, mechanical systems and construction technology. Symbolic relationships with appropriate history, the Earth and spiritual principles are to be searched for and expressed. Finished buildings shall be well built, easy to use and beautiful.

## **Green Building**

“It’s not easy being green.” — Kermit the Frog, 1972.

A green approach to the built environment involves a holistic approach to the design of buildings. All the resources that go into buildings are they materials, fuels or the contribution of the users need to be considered if a sustainable architecture is to be produced. Producing green buildings involves resolving many conflicting issues and requirements. Each design decision has environmental implications.

Measures for green buildings can be divided into four areas :

- reducing energy in use
- minimizing external pollution and environmental damage
- reducing embodied energy and resource depletion
- minimizing internal pollution and damage to health

## **What Makes a Building Green?**

A “green” building places a high priority on health, environmental and resource conservation performance over its life-cycle. These new priorities expand and complement the classical building design concerns: economy, utility, durability, and delight. Green design emphasizes a number of new environmental, resource and occupant health concerns :

- Reduce human exposure to noxious materials.
- Conserve non-renewable energy and scarce materials.
- Minimize life-cycle ecological impact of energy and materials used.
- Use renewable energy and materials that are sustainably harvested.
- Protect and restore local air, water, soils, flora and fauna.
- Support pedestrians, bicycles, mass transit and other alternatives to fossil-fueled vehicles.

Most green buildings are high-quality buildings; they last longer, cost less to operate and maintain, and provide greater occupant satisfaction than standard developments. Sophisticated buyers and lesser prefer them, and are often willing to pay a premium for their advantages. What surprises many people unfamiliar with this design movement is that good green buildings often cost little or no more to build than conventional designs. Commitment to better performance, close teamwork throughout the design process, openness to new approaches, and information on how these are best applied are more important than a large construction budget.

## **Sustainable Design**

Sustainable design is the thoughtful integration of architecture with electrical, mechanical, and structural engineering. In addition to concern for the traditional aesthetics of massing, proportion, scale, texture, shadow, and light, the facility design team needs to be concerned with long term costs: environmental, economic, and human.

The Rocky Mountain Institute outlines five elements for sustainable design:-

- Planning and design should be thorough. Sustainable design is “front loaded” compared with traditional design. Early decisions have the greatest impact on energy efficiency, passive solar design, day-lighting and natural cooling.
- Sustainable design is more of a philosophy of building than a prescriptive building style. Sustainable buildings don’t have any particular look or style.
- Sustainable buildings don’t have to cost more, nor are they more complicated than traditional construction.
- Integrated design, that is design where each component is considered part of a greater whole, is critical to successful sustainable design.
- Minimizing energy consumption and promoting human health should be the organizing principles of sustainable design. The other elements of design can be organized: energy saving architectural features, energy conserving building envelope, and energy-efficient and health-promoting mechanical, electrical, and plumbing systems.

## **Principles of Sustainable Design**

**Understanding Place :** Sustainable design begins with an intimate understanding of place. If we are sensitive to the nuances of place, we can inhabit without destroying it. Understanding place helps determine design practices such as solar orientation of a building on the site, preservation of the natural environment, and access to public transportation.

**Connecting with Nature :** Whether the design site is a building in the inner city or in a more natural setting, connecting with nature brings the designed environment back to life. Effective design helps inform us of our place within nature.

**Understanding Natural Processes :** In nature there is not waste. The byproduct of one organism becomes the food for another. In other words, natural systems are made of closed loops. By working with living processes, we respect the needs of all species. Engaging processes that regenerate rather than deplete, we become more alive. Making natural cycles and processes visible bring the designed environment back to life.

**Understanding Environmental Impact :** Sustainable design attempts to have an understanding of the environmental impact of the design by evaluating the site, the embodied energy and toxicity of the materials, and the energy efficiency of design, materials and construction techniques. Negative environmental impact can be mitigated

through use of sustainably harvested building materials and finishes, materials with low toxicity in manufacturing and installation, and recycling building materials while on the job site.

**Embracing Co-creative Design Processes :** Sustainable designers are finding it is important to listen to every voice. Collaboration with systems consultants, engineers and other experts happens early in the design process, instead of an afterthought. Designers are also listening to the voices of local communities.

### **Policies and Conferences on Sustainable Development**

Sustainable development must take into consideration the wide range of cultures, races, religions and habits of the people who are going to be using and inhabiting the environment. This requires sensitivity and a common approach among the world population and to fulfill this purpose the Summit of Rio (1992) and summit of Johannesburg in September 2002 were held. Suggestions of these summits were:-

- Awareness regarding bio-safety and impact of genetically modified organisms.
- Development of financial resources for environmental improvement.
- Eradication of poverty and sustainable livelihood
- Recognize the negative influences of human activities on environment.
- Control, management and regulation of hazardous waste.
- Transfer of environment friendly technology

As per the suggestions made by the summits, Indian government focused on the environmental policy and formulated the following points :

- Panel measures for industries, which violate pollution control acts.
- Conservation of natural resources by declaration of reserved forests and biodiversity.
- Monitoring and development through Environmental Impact Assessment studies of major industrial and developmental proposal.
- Control further degradation of land, forest and water quality management programmes.

### **Environmental Impact Assessment Process**

EIA is an exercise to be carried out before any project or major activity is undertaken to ensure that it will not in any way harm the environment on a short term or long term basis. Any developmental endeavor requires not only the analysis of the need of such a project, the monetary costs and benefits involved but most important, it requires a consideration and detailed assessment of the effect of a proposed development on the environment.

The environment impact process was introduced with the purpose of identifying evaluating the potential beneficial and adverse impacts of development projects on the environment, taking in to account environmental, social, cultural and aesthetic considerations. All of these considerations are critical to determine the viability of a project and to decide if a project should be granted environmental clearance.

An EIA concentrate on **problems, conflicts** and **natural resource** constraints which might affect the viability of a project. It also predicts how the project could harm to people, their homeland, their livelihoods, and the other nearby developmental activities. After predicting potential impacts, the EIA identifies measures to minimize the impacts and suggests ways to improve the project viability.

**Aim :** The aim of an EIA is to ensure that potential impacts are identified and addressed at an early stage in the projects planning and design. To achieve this aim, the assessment finding are communicated to all the relevant groups who will make decisions about the proposed projects, the project developers and their investors as well as regulators , planners and the politicians. Having read the conclusions of an environmental impact assessment, project planners and engineers can shape the project so that its benefits can be achieved and sustained with out causing adverse impacts.

In recent years, major projects have encountered serious difficulties because insufficient account has been taken of their relationship with the surrounding environment. Some projects have been found to be unsustainable because of resource depletion. Others have been abandoned because of public opposition, financially encumbered by unforeseen costs, held liable for damages to natural resources and even been the cause of disastrous accidents. Given this experience, it is very risky to undertake finance, or approve a major project without first taking in to account its environmental consequences and then sitting and designing the project so as to minimize adverse impacts.

Due to public pressure on the government to accept accountability for the activities of its agencies the National Environmental Policy Act (NEPA) was formed in USA during 1970. This was the basis for the development of a mechanism which came to be known as Environmental Impact Assessment (EIA).

**Role of EIA :** The role for EIA was formally recognized at the earth summit held at Rio conference in 1992. Principle 17 of the Rio declaration states that –

“EIA as a national instrument shall be undertaken for the proposed activities that are likely to have significant adverse impact on the environment and are subject to a decision of a competent national authority”.

**Responsibility of preparation of EIA statement :** The project proponent is responsible for the preparation of the EIA statement, with the help of external consultant or institution.

**The Impact Assessment Agency :** The MOEF is the agency for environmental clearance. If necessary, it may consult a committee of experts with a composition specified in schedule III of notification.

**Timing of EIA :** Ideally EIA should provide information to decision makers at early stage of the project planning cycle. It should be initiated as early as possible before the commencement of projects. If the projects secure approval, EIA should include a provision to cover the audit of the project.

**Cost :** The amount allocated and spent for preparation of EIA by the project proponents are usually abysmally low compared to the overall project costs (often less than 1% of over all projects).

**Process :** There are two ‘tiers’ of assessment which should be applied to the project before proceeding with a full scale EIA, Screening and preliminary assessment. Where these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide that either there is nothing to be concerned about or the evaluation should proceed to the next tier.

The most important step in the process of obtaining environmental clearance under the EIA notification is for the project proponent to conduct an environmental impact assessment of the project. For this purpose the project proponent engages an environmental consultant to prepare an EIA report. The EIA report must be prepared by incorporation of data during all the four seasons of the year. Such an EIA is termed a “**comprehensive EIA**”. However, there is provision for a single season collection of data, but this should not be done during the monsoon season. Such an EIA reports is termed a “**Rapid EIA**”. There are two tiers of assessment which should be applied to the project before proceeding with a full scale EIA :

Screening and Preliminary Assessment. Wherever these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide whether there is anything to be concerned about or whether the evaluation should proceed to the next tier.

### **Preparation required before starting EIA**

**Screening :** The screening is the first and simplest tier in project evaluation. Screening helps to clear those types of projects, which from past experience are not likely to cause significant environmental problems. The activity may take one of the following several forms :

1. Measurements using simple criteria such as size or location.
2. Comparing the proposal with list of projects rarely needing an EIA (e.g. schools) or definitely needing one (e.g. coal mines).
3. Estimating general impacts (e.g. increased in infrastructure needed) and comparing these impacts against set thresholds.
4. Doing complex analyses, but using readily available data.

**Preliminary Assessment :** If screening does not clear a project, the developer may be required to undertake a preliminary Assessment. This involves sufficient research,

review of available data and expert advice in order to **identify the key impacts** of the project on the local environment, **predict the extent of the impacts** and briefly **evaluate their importance** to decision makers. The preliminary assessment can be used to assist early project planning (for instance, to narrow the discussion of possible sites) and it can serve as an early warning to the serious environmental problems that the project may cause. It is in the developer's interest to do a preliminary assessment since, in practice, this step can clear projects of the need for a full EIA.

**Formation of an EIA Team :** If after reviewing a preliminary assessment the competent authority deems that a full EIA is needed, the next step for the project developer is the preparation of the EIA report. This entails:-

1. Commissioning and briefing an independent co-coordinator and expert study team.
2. Identifying the key decision makers who will plan, finance, permit and control the proposed project, so as to characterize the audience for the EIA.
3. Researching laws and regulations that will affect these decisions.
4. Making contact with each of various decision makers.
5. Determining how and when the EIAs finding will be communicated.

**Scoping :** The first task of the EIA study team is scoping the EIA. The aim of scoping is to ensure that the study address all the issues of importance to the decision makers. First of all the team's outlook is broadened by the discussions (with the project proponents, decision makers, the regulatory agency, scientific institutions , local community representative and others) to include all the possible issues and concerns raises by various groups. Then the study team selects primary impacts for the EIA to focus upon depending on the basis of magnitude, geographical extent, significance to decision makers or because the area is special locally (e.g. soil erosion, the presence of an endangered species, or a near by historical sites) or is an eco-sensitive area.

**Main EIA :** After "scoping" the main EIA begins. The EIA attempts to answer five questions basically:

1. What will happen as a result of the project?
2. What will be the extent of the changes?
3. Do the changes matter?
4. What can be done about them?
5. How can decision makers be informed of what needs to be done?

The EIA becomes a cyclic process of asking and further asking the first four questions until decision makers can be offered workable solutions.

**Identification :** Identification means the answer to the first question, i.e. "what will happen as result of the project?" If a preliminary assessment has been done it will have broadly reviewed the projects effect, also scoping will have focused the study on the most important issues for decision makers. Taking these findings in to account the full EIA study now formally identifies those impacts which should be assessed in detail.

This identification phase of the study may use these or other methods :

1. Compile a list of key impacts (e.g. changes in air quality, noise levels, wild life habitats, species diversity, landscape views, social and cultural systems, settlement patterns and employment levels from other EIA s for similar projects)
2. Name all the projects sources of impacts (e.g. smoke emissions, water consumption, construction jobs) using checklists of questionnaires, then list possible receptors in the environment (e.g. crops, communities using same water for drinking, migrant of labour) by surveying the existing environment and consulting with interested parties.
3. Identify impacts themselves through the use of checklist, matrices, networks, overlays, models and communication.

**Prediction :** The next step called predictions answers the EIA's second question: "what will be the extent of the changes". As far as is practicable, prediction scientifically characterizes the impacts causes and effects and its secondary and synergetic consequences for the environment and the local community. Prediction follows an impact within a single environmental parameter (e.g. toxic liquid effluents) in to its subsequent effects in many disciplines (e.g. reduced water quality, adverse impacts on fisheries, economic effects on fishing villages, and resulting socio-cultural changes). Prediction draws on physical, biological, socioeconomic and anthropological data techniques .In quantifying impacts, it may employ mathematical models, physical models, socio cultural models, economic models, experiments or expert judgments.

All prediction techniques by their nature involve some degree of uncertainty. So along with each attempt to quantify an impact, the study team should also quantify the predictions uncertainty in terms of probabilities or margins of error.

**Evaluation :** The third question addressed by the EIA – do the changes matter is answered in the next step. Evaluation is so called because it evaluates the predicated adverse impacts to determine whether they are significant enough to warrant mitigation. Thus judgment of significance can be based on one or more of the followings:

1. Comparison with laws, regulations or accepted standards.
2. Consultation with the relevant decision makers.
3. Reference to pre set criteria such as protected sites features of species.
4. Acceptability to the local community or the general public.

**Mitigation :** In this phase the study team formally analyses mitigation. A wide range of measures are proposed to prevent, reduce, remedy or compensate for each of the adverse impacts evaluated as significant. Possible mitigation measures include:

1. Changing project sites, routes, processes, raw materials, operating methods, disposal methods, disposal routes or locations, timing or engineering designs.
2. Introducing pollution controls, waste treatment monitoring, phased implementation, landscaping, personal training, special social services or public education.

3. Offering (as compensation) restoration of damaged resources, money to affected persons, concessions on other issues, or off site programmes to enhance some other aspects of the environment or quality of life for the community.

All mitigation measures cost something and this cost must be quantified too. These various measures are then compared, trade-offs between alternative measures are weighed, and the EIA study team proposes one or more action plans, usually combining a number of measures. The action plan may include technical control measures, an integrated management scheme (for a major project) monitoring, contingency plans, operating practices, project scheduling, or even joint management (with affected groups). The study team should explicitly analyze the implications of adopting different alternatives, to help make the choices clearer for the decision makers.

Several analytical techniques are available for this purpose as given below :

1. Cost benefit analysis in which all quantifiable factors are converted to monetary values, and actions are assessed for their effect on project costs and benefits
2. Explaining what course of action would follow from various broad 'value judgments' (e.g. that social impacts are more important than resources)
3. A simple matrix of environmental parameters versus mitigation measures, contain brief description of the effects of each measure.
4. Pair wise comparisons, whereby the effects of an action are briefly compared with the effects of each of the alternative actions are briefly compared with the effects of each of the alternative actions, one pair at a time.

**Documentation :** The last step in the EIA process, which answers the question – how decision makers be informed of what needs to be done? In documenting an EIA, this means identifying the key decisions makers, perceiving the question they will be asking and providing them with straight forward answers formatted for easy interpretation in relation to their decision making (e.g. tables, graphs, summary, points). Successful EIA documentation is more readily produced if the audience and their needs are established at the start of the EIA, and then made to affect how the research is focused and reported. It is the job of the study team's communications expert to make this happen. An EIA report should contains :

1. An executive summary of the EIA findings.
2. A description of the proposed development projects.
3. The major environmental and natural resource issues that needed clarification and elaboration.
4. The projects impacts on the environment (in comparison with a base line were identified and predicated.).
5. A discussion of options for mitigating adverse impacts and for shaping the project to suit its proposed environment, and an analysis of the trade offs involved in choosing between alternative actions.



6. An over view of gaps or uncertainties in the information.
7. A summary of the EIA for the general public.

Once the EIA reports has been completed, the project proponent needs to submit 20 copies of the copy of executive summary of the proposed proposal containing the salient features of the project, the form XII prescribed under water rules, 1975, form I prescribed under Air rules, 1983 and other information or documents to the SPCB for getting the non clearance certificate (NOC). On receiving the required documents from the project proponents it is the responsibility of the SPCB to conduct the public hearing. After completion of the public hearing the project proponents has to submit to the secretary of MOEF for the environmental clearance.

### **Conclusion**

Sustainable development is defined as development that meets the need of the present without compromising the ability of future generations to meet their own needs. It also considers the equity between countries and continents, races and classes, gender and ages. It includes social development and economic opportunity on the one hand, and the requirements of the environment on the other. It is based on improving the quality of life for all, especially the poor and derived within the carrying capacity of the supporting ecosystems. It is a process which leads to a better quality of life while reducing the impact on the environment. Its strength is that it acknowledges the interdependence of human needs and environmental requirements.

### **SHORT ANSWER**

1. What is sustainable development?
2. What is vermicomposting?
3. What is Integrated Pest Management (IPM)?
4. Discuss the role of EIA.
5. How the “Timing” of EIA is to be decided?
6. Discuss the “evaluation” in EIA.
7. What is “Prediction” in EIA?
8. What is “Scoping” in EIA?
9. What is “Screening” in EIA?
10. How to form the “Team” of EIA?

### **LONG ANSWER**

1. Discuss the role of sustainable development in environment management.
2. What is environmental biotechnology?
3. Explain the various sources of energy in Uttarakhand.

4. Discuss the sustainable development in detail.
5. Discuss the consumerism and sustainable development.
6. What are the recommendations of world summit on sustainable development?
7. Discuss the process of EIA process.
8. Discuss the purpose of EIA in detail.
9. Discuss the “Mitigation” in EIA.
10. Discuss the “Documentation” in EIA.

### **TRUE/FALSE**

1. Harnessing of resources is the part of sustainable development.
2. EIA team works under the control of government.
3. “Single season collection data report” is called as Rapid EIA.
4. Detail description of EIA is given in principle 19 of Rio conference 1992.
5. NEPA was formed in 1970.
6. Summit of Johannesburg held in September 2002.
7. Sustainable development has 5 dimensions.
8. NEERI is environmental planning organization.
9. The Norwegian Prime Minister suggested the definition of Sustainable development in 1997.
10. Sustainable development proposed the concept of “Green Buildings.”

### **FILL IN THE BLANKS**

1. The term ‘Sustainable development’ was adopted in year \_\_\_\_\_.
2. The term ‘Sustainable development’ was adopted in the summit of \_\_\_\_\_.
3. Productivity of the land falls due to \_\_\_\_\_.
4. Sustainable development is also known as \_\_\_\_\_.
5. Sustainable agriculture concentrates on \_\_\_\_\_.
6. IPM stands for \_\_\_\_\_.
7. Total power generation capacity of India is \_\_\_\_\_ MW.
8. GIS stands for \_\_\_\_\_.
9. Three dimensions of sustainable development are \_\_\_\_\_, \_\_\_\_\_ & \_\_\_\_\_.
10. Complete EIA Project needs to be submit \_\_\_\_\_copies executive summary.

## CHAPTER

# 4

## Natural Resources

### Natural Resources

Resource is anything needed by an organism, group of organisms or organization. In other words, a resource is something useful, but for humanity what is useful or useless can change because of environment and environmental impacts of getting and using resource.

The continuity of a resource may also depend on the impact, mining, processing. And use for the environment. Even if affordable supplies of a resource are available, its use may have to be abandoned if this use seriously threatens human and other forms of life. Sometimes the environmental effects of a resource can be minimized and cleaned up. But this costs money and in some cases the cost may be so high that we can no longer afford to use the resource.

What are Natural Resources?

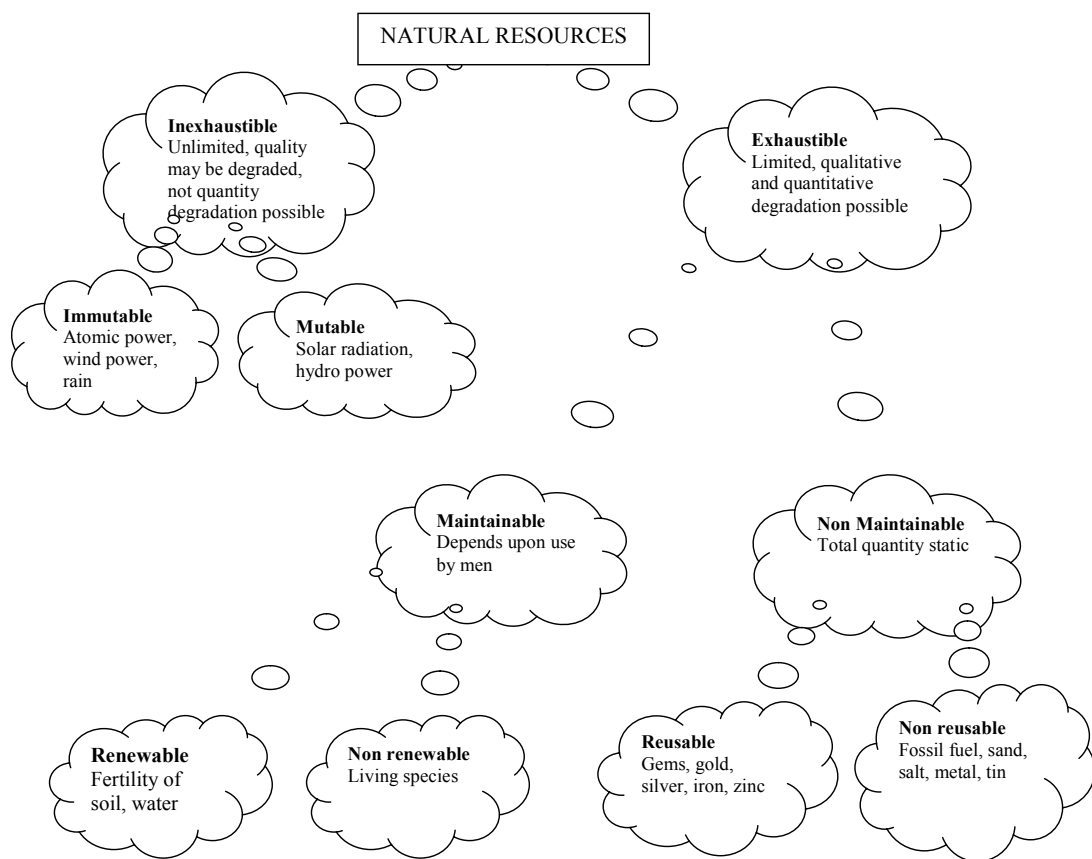
The some of all physical, chemical and biological and social factors which compose the surroundings of man is referred to as environment and each element of these surroundings constitutes a resource on which man draws in order to develop a better life. Thus, any part of our natural environment – such as land, water, air, minerals, forest, wildlife, aquatic life and human population, which a man can utilize to promote his welfare, may be considered as natural resources.

Natural resources can be also defined as resources as form of energy or matter which is essential for the functioning of the organisms, populations and ecosystem. In the case of humans, a resource is any form of energy or matter essential for the fulfillment of physiological, socio-economic and cultural needs both at the individual level and that of the community.

The functioning of ecosystem or of technological civilization involves a continuous flow and consumption of energy. Sun being the source of it as regards ecosystem and fuel as regards technological civilization. In the light of this fact, a resource may be defined as one of the various forms of primary energy present in the nature. The five basic ecological variables such as energy, matter, space, time and diversity are sometimes combinedly called Natural Resources.

### Various forms of natural Resources

Initially there are two forms of resources as renewable and non-renewable resources. Renewable sources are those which are reproducible and are obtained from the biomass of living organism as *terrestrial animals* and *aquatic animals*. Resources which are not reproducible and are obtained from the finite non living reserves are called non renewable resources as *coal* and *metals*. Solar energy although having a finite life, is considered as a renewable resources in as much as solar stocks are inexhaustible on the human scale.



**Fig. 4.2. Different forms of resources, proposed by Owen (1971)**

Most ecologists prefer to classify resources as into biotic (living) and abiotic (non-living) resources. According to Owen (1971) resources can be further classify on the basis of attributes as quantity, mutability and reusability. Inexhaustible and exhaustible are the main categories of resources based on their stocks in nature. Inexhaustible resources are further divided into two groups, immutable and mutable resources, depending upon the possibility of their qualitative degradation as a result of man's activity. Exhaustive

resources, being limited in occurrence, are valuable to both quantitative and qualitative degradation. Thus their availability depends on the method of use, therefore, these are classified into maintainable and non-maintainable resources. Supply of maintainable resources could be made to last for the long period through wise use, some of them have capacity to reproduce called renewable, while other cannot reproduce called non-renewable resources. Non-maintainable resources have static supply and when destroyed or consumptively used are irreplaceable, yet some of them have potentiality for reuse called reusable resources and rest whose permanent exhaustion seems to be certain are called non-reusable resources.

### **Water Resource**

Water is a gift on the earth and it is an important natural resource. Plants and animals have 60-65% water in their body. Water has following characteristics:

1. It exists as a liquid over wide range of temperature ( $0^{\circ}$  to  $100^{\circ}$  C).
2. It can dissolve several nutrients in it, which helps the plants to take all required nutrients from the soil.
3. Water has high latent heat of vaporization due to which it produces a cooling effect as it evaporates.
4. It has anomalous expansion behavior.
5. It has high specific heat due to which it warms up and cools down very slowly without, which is very beneficial for aquatic diversity.

How the water appears on the earth is not clear so far. However, according to the most acceptable assumption is that initial earth had no oceans and perhaps very little atmosphere. It is believed that the volatile constituents bound in the earth's crust, oozing the surface through volcanoes, rock movements and hot springs, condensed to form the ocean and the atmosphere. This way, perhaps this remarkable combination of hydrogen and oxygen (water), came into existence and became the indispensable component of the earth.

Total water in the world is estimated to be 1.5 billion cu km. about 95% of this is the salt water of ocean. This comes to around 1.425 billion cu km, remaining 5% is fresh water (75 million cu km). out of this 60 million cu km is immobilized as continuously frozen polar ice and snow, remaining 15 million cu km as fresh liquid water for human, animal and plants.

Of the 15 million cu km of fresh water about 1% (150000 cu km) is surface water found in rivers, lakes and streams and 99% is stored underground at various depth. About half of the ground water (700000 cu km) is stored at depth of greater than 1,000 meters and is considered too expensive to pump to the surface of most uses. So total usable water in the world is 7 million cu km of fresh ground water at reasonable depth.

## Hydrological cycle

Consumable water is obtained through precipitation. Precipitation occurs by the unending moisture cycle of the earth called hydrological cycle. Moisture is constantly circulating between the land, the ocean and the atmosphere. This hydrological cycle has neither a beginning nor an end. Radiation from the sun evaporates water from the ocean, rivers, lakes into the atmosphere. Transpiration also takes place from the vegetation and adds water to the atmosphere. The water vapour rise and collects to form clouds. Under certain conditions, the cloud moisture condenses and fall back to the earth as rain, hail and snow.

The whole process is presented in following picture :

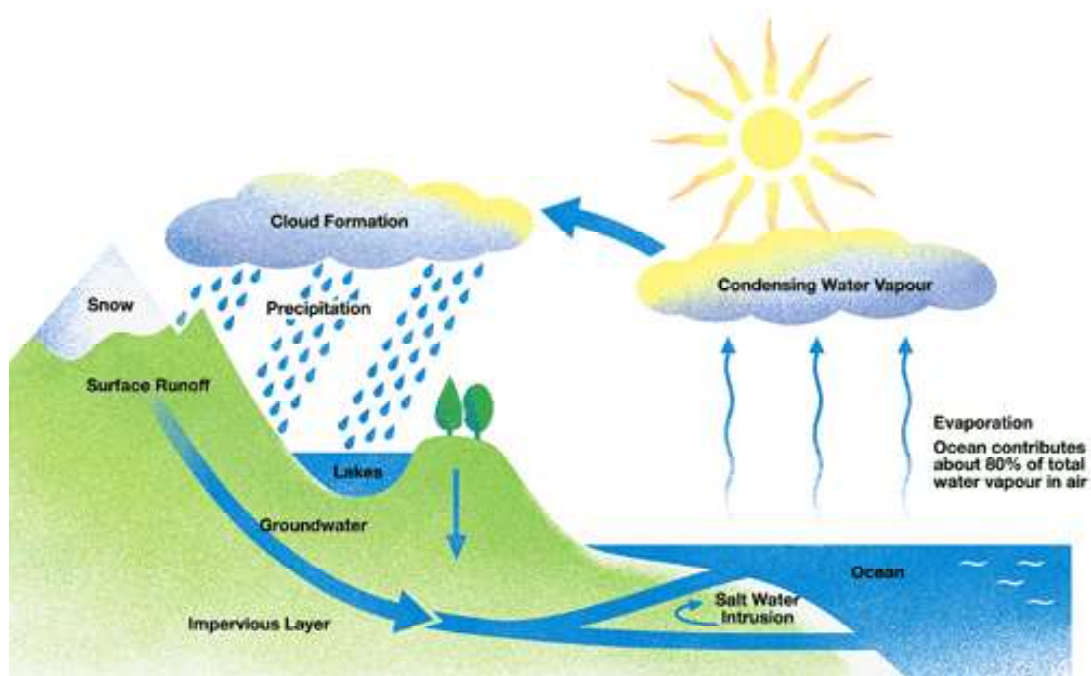


Fig. 4.2. Hydrological Cycle

## Precipitation

On an average, India receives about 120 cm of precipitation in a year, mostly as rainfall. On volume basis this is 394.5 million hectare meter (m. ham.). The main source of precipitation is rainfall. Rainfall over the entire country during the monsoon is nearly 75% of the mean annual, while during pre-monsoon and post-monsoon seasons the country receives almost the same amount of rainfall which is about 10 to 12% of the mean annual. In January and February the country receives just about 3.5% of the mean annual rainfall and it is mostly confined to Assam, Jammu & Kashmir, Punjab, North-west Uttar Pradesh.

**Table 4.1. Rainfall during various seasons through out the year**

	Season	Duration	Rainfall (in %)
1.	Pre-monsoon	March - May	10-12 %
2.	Monsoon	June - September	76%
3.	Post Monsoon	October - December	10-11%
4.	Winter season	January - February	3-5%

On the basis of annual rainfall, different regions of country can be divided into three categories viz. high rainfall areas, medium rainfall areas and low rainfall areas. The areas receiving above 1,150 mm annual rainfall are high rainfall areas, those receiving around 750 mm annual rainfall are medium rainfall areas and the areas with annual rainfall below 750 mm are low rainfall areas.

The factor which controls the process of evaporation and Eva-transpiration include temperature, humidity and wind. It is a continuous process going on day and night from the ocean surface, ground surface, inland water (lakes and streams), plant and animal surfaces. Rising in the atmosphere this water forms clouds that float around in gaseous or droplet form. The atmosphere above the earth up to varying height of 10 to 17 km (according to season) is called the troposphere up to which the clouds float and in which all weather changes take place. Water returns to the earth in the form of precipitation, most of which takes place over the ocean and a little on the land surface. Rainfall on the land surface may have:- (a) it may percolate through the soil and become a part of ground water regime, (b) accumulate in a pond, lake or reservoir as inland surface water, flow down to the ocean in the form of stream, (c) taken up by plants and animals, and (d) evaporate.

### **Different forms of Water Resources**

As per to the uses water resources may be classified into three main groups:-

**1. Consumptive use :** Irrigation, urban and rural water supplies are grouped in this category i.e. water is directly used by living beings.

**2. Partial Consumptive use :** Use of water of domestic and industrial purposes, thermal and nuclear power generation, are come under this category, as a part of the water can be renewed for reuse after proper conditioning.

**3. Non Consumptive use :** This includes the quantity required for hydro-power generation, navigation, pollution control, creation, preservation fish and wild life.

### **Water resources available in Indian conditions**

India chiefly based on the monsoon for the optimum agricultural yield. According to geographical structure of India, water resources can be classified into two major categories :

**(a) Ground water (beneath the surface) :** Ground water is also known as “fossil water”, as it was deposited thousand ago. After precipitation or seepage, water percolates under the influence of gravity. This result in the formation of two zones :

**(i) Aeration zone :** It consists of voids, which are not saturated with water.

**(ii) Saturation zone :** It is present below aeration zone. This zone is consists of voids, saturated with water. Water table is present between these two zones.

Due to depletion of groundwater, the land may sink and called as land subsidence.

**(b) Surface water (streams, lakes, reservoirs and ponds) :** The precipitation that falls on land is the ultimate source for the both type of water resources (surface and ground water). When it rains, a large portion is intercepted by the vegetation, or detained in surface depression. When the available interception or the depression storages are completely exhausted and when the rainfall intensity at soil surface exceeds the infiltration capacity of the soil, and the over land flow begins. This water reaches to the rivers, lakes, reservoirs and dams. Our irrigation mainly depends on the surface water resources. Runoff water from streams and rivers is stored in reservoirs or diverted through canal system for irrigation.

### Water Resources utility

All the water present in environment is utilized mainly for three reasons:-

1. Irrigation
2. Industrial
3. Domestic
4. Mining
5. Power generation

**1. Irrigation :** Irrigation is the major consumptive unit of water resources. Irrigation is mainly carried out through minor irrigation schemes as well as major and medium irrigation schemes.

	Sources	Area in million hectare	% in total area
1.	Tubewells	11.26	26.7
2.	Tanks	3.30	8.1
3.	Government canals	15.41	36.4
4.	Private canals	0.48	1.1
5.	Other sources	11.32	27.7
	Total irrigated areas	41.77	

**Fig. 4.2. Percent wise contribution of irrigation sources**

**2. Industrial :** In different industrial processes like fabricating, processing, washing, diluting, cooling, etc. water is required.



**3. Domestic :** Water is used for the various household purposes like washing, cooking, watering plants and sanitation, etc.

**4. Mining :** Various processes of mining such as, extraction of minerals requires large amount of water.

**5. Power generation :** All type of power generation require water. Hydroelectricity is produced, when falling water rotates turbines. Apart of this, in thermal power generation plant, water is second most important commodity after fuel.

Apart of above mentioned utility, water has some more unique properties due to which it has various uses for living organisms like:-

1. Plants take nutrition from soil through root because water dissolves all such nutrients in it.
2. Removal of physiological wastes is also mediated through water.
3. Water maintains the body temperature and distribute the nutrients to all body parts.
4. It is also used in industries as coolant and waste disposal.

### **Over-exploitation of Water and its Impact**

Due to population explosion the demand of water has been increased, which resulted over-exploitation of water that causes many problems like fall of water table due to which wells and tube wells are drying. The places where excessive water is exploited and unnecessary wastage causes water logging and soil erosion.

Over exploitation occurs at various levels, most people use more water than they need, even the farmers are irrigating their crops more than needed.

Reasons of over-exploitation of water :

According to the National Water Development Agency, there are several reasons for the over-exploitation of the water resources. Some of them are being listed below

- Population explosion
- Mining
- Rapid industrialization
- Modern agricultural techniques
- Urbanization
- Uncontrolled use of wells

Overexploitation can cause various severe problems:-

**1. Lowering of water table :** with the increase population and increasing area of dry land, there is a large exploitation of underground water due to which water level is lowering down day after day, so it causes threat for future agriculture because of reduce water supply.

**2. Water logging :** In certain cases, if excessive irrigation is done, it will raise the water level, and salt which is found in the rocks when come in contact with this water, it moves up when evaporation takes place in upper soil layer, so it results salinity in the soil.

### **Management of water resources – Dams and their Impact**

Damming rivers is an ancient practice that serves several useful purposes, such as flood control, irrigation of dry land, and providing a nonpolluting source of electricity generation. This modern world more than 46000 dams are there, which play an important role in the development processes like irrigation, hydroelectricity, fisheries, entertainment, navigation and water supply etc. Dams are the water reservoir on which we can rely to face short term drought conditions. About 40% of the irrigated land of the world relies on the dams. Around 19% of electricity demand of the world are fulfilled by dams in the form of hydro-electricity.

### **Benefits of Dams**

1. Dams control flow of water and minimize flood damage.
2. They protect soil erosion by regulating flow of water.
3. Conserved water can be used for irrigation purposes.
4. Dams make water available for industrial purposes and for domestic purposes during drought.
5. Dams also produce employment to local as well as other people.
6. Artificial lake which comes in existence because of dam increases the tourism.
7. Dam's reservoir can also be used for the fisheries production.

Some major hydro-projects of India are :

1. Rihand Project (Uttar Pradesh)
2. Hirakund Dam (Orissa)
3. Damodar valley project (Jharkahnd & West Bengal)
4. Bhakra Nangal project (Punjab)
5. Sardar Sarovar Project (Gujrat)
6. Tehri Dam (Uttrakhand)

Apart of positive aspects of dams, there are certain negative sides also :

1. Dams disturbed the ecosystem of that particular area.
2. Physical transformation and fragmentation of rivers.
3. Water-logging and salinity of surrounding areas.
4. Rapid industrialization.
5. Damage to plants and animals of that particular area which is submerged in water.

6. Change in the micro-climate i.e., temperature, humidity, rainfall, of that particular area.
7. Tectonic activities of the region.
8. Social and legal consequences of large dams are due to the displacement of people and their rights regarding compensation.
9. There is emission of green house gases from the dams due to rotting of living organisms, which are submerged in water.
10. Conflicts over the water resources and dams among the states have been increased, which is not good for the national interest. Some of the major conflicts of the states and with neighboring countries are list below :

	Name of Project	Conflicting Parties
1.	Satlaj – Jhelum project	India and Pakistan
2.	Ganga water dispute	India and Bangladesh
3.	Kosi- water dispute	India and Nepal
4.	Cauvery water dispute	Karnataka and Tamilnadu
5.	Satlaj- Yamuna link canal	Punjab and Haryana
6.	Yamuna water dispute	Delhi and Haryana

### Mineral Resources

A *mineral resource* is a concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a mineral resource are known, estimated or interpreted from specific geological evidence and knowledge. Mineral resources are sub-divided, in order of increasing geological confidence, into inferred, indicated and measured categories.

An *inferred mineral resource* is that part of a mineral resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. An *indicated mineral resource* is that part of a mineral resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits,

workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed. A *measured mineral resource* is that part of a mineral resource for which quantity, grade or quality, densities, shape and physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity.

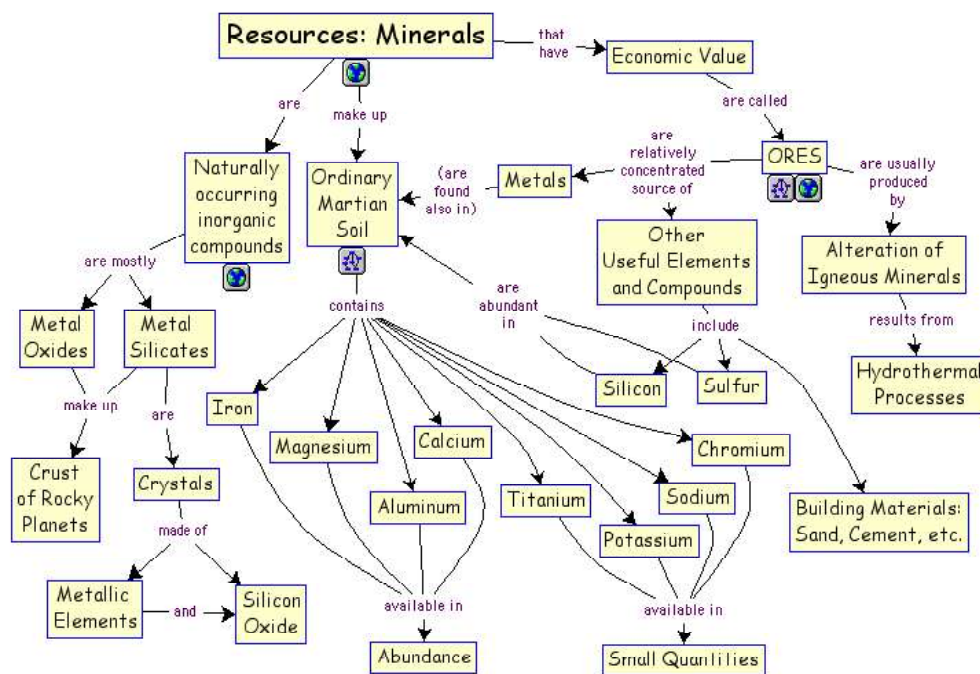


Fig. 4.4. Various forms of mineral resources

Mineral resources, which are not mineral reserves, do not have demonstrated economic viability. A *mineral reserve* is the economically mineable part of a measured or indicated mineral resource demonstrated by at least a preliminary feasibility study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A mineral reserve includes diluting materials and allowances for losses that may occur when the material is mined. Mineral reserves are sub-divided in order of increasing confidence into probable mineral reserves and proven mineral reserves. A *probable mineral reserve* is the economically mineable part of an indicated and, in some circumstances, a measured mineral resource demonstrated by at least a preliminary

feasibility study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A *proven mineral reserve* is the economically mine-able part of a measured mineral resource demonstrated by at least a preliminary feasibility study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction is justified.

### **Forest Wealth**

The word 'Forest' is derived from Latin word 'foris' meaning outside, the reference being to village boundary of fence, and must have included all uncultivated and uninhabited land. Toda a forest is nay land managed for the diverse purpose of forestry whether covered with trees, shrubs, climbers etc. Indian word 'Jungle' has been adapted in the English language to describe the collection of trees, shrubs, etc. Legally, a forest is any land, including the vegetation growing on it, that has been so declared under a legal enactment.

### **Nature of Forest**

Forests are one of the most striking features of the land surface. They vary greatly in composition and density, and stand in marked contrast to meadows and pastures. Certain forests are evergreen, like Deodar forests of Kashmir, while others are deciduous, becoming leafless either before the advent of winter when vegetative activity almost ceases, such as the oak forests of the Himalayas, or else just before the onset of intense dry summer, to reduce transpiration to the minimum, like the teak forests of the Central India.

Forests are the renewable source and contribute substantially to economic development. They have a major role of enhancing quality of environment. India has an area of 633.5 lakh hectare notified as forests, of this, 406.1 lakh hectare area is classified as reserved and 215.1 lakh hectare is protected. Unclassified Forest area is spread over 13.1 lakh hectare. About 19.27 percent of the total geographical area is under actual forest cover. However, out of this dense forest (crown density more than 40%) accounts for 11%, open forest (crown density 10% to 40%) represents 8% while mangrove forest occupies 0.15%.

### **Types of Forests**

The vast expanse of the country spread over regions from temperate to sub-tropical zones coupled with wide varieties of relief, temperature and rainfall. The country provides ideal natural condition for the growth of forests that would represent the range and variety of forests species that could rarely be found in any single country of the world.

**Tropical Wet Evergreen Forests :** They are tropical wet evergreen forests occur in the Western Ghat, and hilly areas of Assam and Northeastern regions. These areas are those having the highest rainfall in the country (around 2500mm/year).

**Tropical Semi-evergreen Forests :** The rainfall regimes of 1900-2500 mm per annum holds Tropical semi-evergreen varieties.

**Tropical Moist Deciduous Forests :** Tropical moist deciduous type finds their natural habitat in the regions having annual rainfall of 1250 mm to 1900 mm.

**Tropical Dry Deciduous Forests :** The next below rainfall regime, 750-1250 mm holds the Tropical dry Deciduous Forests.

**Tropical Thorne Forests :** Areas having lesser rainfall have developed Tropical Thorne forests ultimately leading to a practical absence of vegetation in the arid and desertic tracts.

Apart of these, a very different variety of forests exists in the different zones of the Himalayas. The southern most ranges of the western Himalaya holds the **subtropical pine forests**. Higher rainfall in the Eastern Himalaya brings about a belt of **Wet Temperate Forests** immediately above that. These are followed northwards or in other words in the higher ranges by **Moist Temperate** and **Dry Temperate forests** ultimately leading to the **Alpine forests** in the highest ranges.

### Role of Forests

Forests play a very important role in the **Life** and **Economy** of the country. Forest vegetation and its accompanying soil organism make up as much as 90 per cent of the total Biomass on land.

- (a) Due to deforestation, the stability of many ecological sub-systems have been greatly disturbed.
- (b) Forests cover in the catchment areas of the river, control soil erosion and recurrence of flood. Once the forest cover is damaged, severe soil erosion takes place disturbing the entire eco-system, choking the dams and reservoirs with silt load and thereby promote recurrence of floods.
- (c) Forests cover is effective in checking the spread of desert by putting up a barrier.
- (d) Trees bring relief to the population by keeping the temperature under control, ensure adequate and stable rainfall year after year.

Forests have a direct, intimate and profound relationship with the **economy** of the Indian people. This is one of those natural wealth which is shared by the rich and poor alike and is virtually indispensable. Population derive great benefits from the forest in day today life and also for economic growth of the country. So, the importance of forests are :

- Forests regulate local climate, rainfall and hydrological cycle. It absorbs solar heat during evaporation-transpiration, maintaining CO<sub>2</sub> and O<sub>2</sub> level on the earth through photosynthesis.
- Forest provide employment opportunities to the people. In India 96% of the forests are under the control of forests authorities. It is estimated that more than eight crore people are getting employment because of forest based industries.

- Forests are the source of medicinal plants which are used for traditional medicines and are acting as potential source for the modern drugs.
- Forests are the major factors of environment concern, providing protection to wild life, help in gaseous cycles of atmosphere, tend to enhance water holding capacity of soil, maintain the soil fertility, regulate the earth's temperature etc.
- Forests give us many valuable essential oils, gums, resins, bamboos and dyes.
- Forests are used for Sericulture (silk production), Apiculture (Honey production) and Lac culture (Lac production).
- Forests have aesthetic and tourist values and serve as gene reserve of important plant and animal species.

### **Forests Products**

The forests products have been classified under two headings :

**(a) Major Products :** Timber pulp and match wood, round wood, firewood, charcoal wood, etc.

**(b) Minor Products :** Bamboos and canes, fodder and grass, gums and resins, lac, drugs and spices, tans-tuff and dye stuff, seeds, tendu leaves, honey and lac etc.

### **India's Forest Policies**

Development of forests is guided by the policies adopted by a nation to manage them.

### **National Forest Policy of 1988**

It was strongly suggested that a modified set in the previous policies as Forest policy of 1894 and Forest policy of 1952 is much needed in changing scenario. Therefore, following suggestions were proposed in the form of new Forest policy in 1988.

- Officers with the right attitude should be posted in reserved forests and sanctuaries.
- Forest development corporations should be asked to take up plantations on steep hillsides, catchment areas and cleared forest areas so that the productive forest and protective forestry go hand in hand.
- A massive programme of social forestry should be taken up both under food for work and other specific schemes.
- In areas where tribals depend heavily on forests for their livelihood, they should be involved in replanting the species they exploit.
- The existing rules, regulations and security arrangement in sanctuaries should be tightened.

**Conclusion**

Natural resources can be defined as resources as form of energy or matter which is essential for the functioning of the organisms, populations and ecosystem. In the case of humans, a resource is any form of energy or matter essential for the fulfillment of physiological, socio-economic and cultural needs both at the individual level and that of the community.

A *mineral resource* is a concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction.

**SHORT QUESTION**

1. What are the natural resources?
2. What do you understand by renewable and non renewable resources?
3. Discuss the utility of the Dams.
4. Discuss the hydrological cycle.
5. Discuss the negative aspects of Dams.
6. How many types of forests are present in environment?
7. Describe the forest conservation and management.
8. What id fertility of land?
9. Discuss the holistic approach to develop natural resources.
10. How biodiversity influence the natural resources?

**LONG QUESTION**

1. How the Dams can influence the social and ecological factors?
2. Discuss the different forms of resources, proposed by Owen.
3. Discuss the precipitation pattern in India
4. How the precipitation and hydrological cycle is interrelated?
5. Discuss in detail the importance of the forest resources.
6. What are the minerals resources?
7. Describe the prevention of food crisis.
8. Describe in brief the importance of forest resources.
9. What do you understand by environmental ethics?
10. Discus in detail about the resources management.



**TRUE/FALSE**

1. National forest policy was proposed in 1988.
2. Solar radiation is Immutable resource.
3. India receives 10-12% rainfall during winter season.
4. Hirakund dam is situated in Orissa.
5. Tropical dry deciduous forests receives 750-1250 mm of rainfall.
6. The forest cover in India is 60%.
7. The red list is prepared by WWF.
8. Kanha is the first national park of India.
9. Herb stage is the stable community.
10. National parks are the ex-situ conservation.

**FILL IN THE BLANK**

1. India receives \_\_\_\_\_ cm of precipitation per year.
2. Gems, gold and silver are \_\_\_\_\_ resources.
3. June-September is considered as \_\_\_\_\_ season.
4. Government canals irrigate \_\_\_\_\_ million hectare area.
5. \_\_\_\_\_ % of the total geographical area is under actual forest cover.
6. Chipko movement was started to conserve \_\_\_\_\_.
7. \_\_\_\_\_ is the eco-friendly energy.
8. Trees are predominant in \_\_\_\_\_ ecosystem.
9. The valley of flower is located in \_\_\_\_\_.
10. The highest number of organism belong to \_\_\_\_\_.

## CHAPTER

# 5

## Biogeochemical Cycles

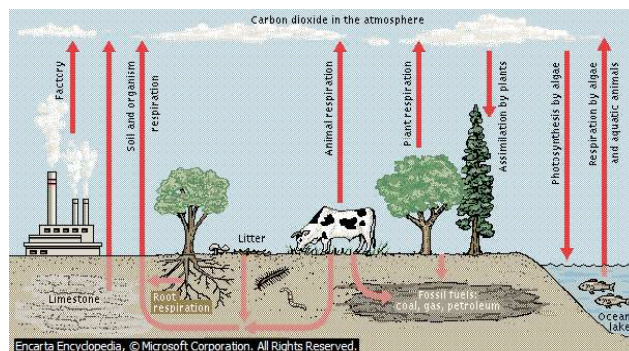
### Material cycles

The elements that enter into the composition of living organisms circulate in more or less circular paths in the biosphere from environment to organisms and back to the environment. These paths are known as *Biogeochemical cycles* or *Material cycles*. The movement of these elements and inorganic compounds that are essential to life can be conveniently designed as *nutrient cycles*. These cycles ensure the availability and reuse of inorganic compounds necessary for life. There are three major types of cycles:-

1. Hydrological cycles (water)
2. Gaseous nutrient cycles (N, C and O<sub>2</sub> )
3. Sedimentary nutrient cycles (P, S, Hg, Pb, Cd and Cr)

### Carbon Cycle

Carbon Cycle (ecology), in ecology, the cycle of carbon usage by which energy flows through the Earth's ecosystem. The basic cycle begins when photosynthesizing plants use carbon dioxide (CO<sub>2</sub>) found in the atmosphere or dissolved in water. Some of this carbon is incorporated in plant tissue as carbohydrates, fats, and protein; the rest is returned to the atmosphere or water by respiration. Carbon is thus passed on to herbivores that eat the plants and thereby use, rearrange, and degrade the carbon compounds. Much of it is given off as CO<sub>2</sub> in respiration, as a by-product of metabolism, but some is stored in animal tissue and is passed on to carnivores feeding on the herbivores. Ultimately, all the carbon compounds are broken down by decomposition, and the carbon is released as CO<sub>2</sub> to be used again by plants.



**Fig. 5.1. Carbon Cycle**

### Air Water Exchange

On a global scale the carbon cycle involves an exchange of  $\text{CO}_2$  between two great reservoirs: the atmosphere and the Earth's waters. Atmospheric  $\text{CO}_2$  enters water by diffusion across the air-water surface. If the  $\text{CO}_2$  concentration in the water is less than that in the atmosphere, it diffuses into water, but if the  $\text{CO}_2$  concentration is greater in the water than in the atmosphere,  $\text{CO}_2$  enters the atmosphere. Additional exchanges take place within aquatic ecosystems. Excess carbon may combine with water to form carbonates and bicarbonates. Carbonates may precipitate out and become deposited in bottom sediments. Some carbon is incorporated in the forest-vegetation biomass (living matter) and may remain out of circulation for hundreds of years. Incomplete decomposition of organic matter in wet areas results in the accumulation of peat. Such accumulation during the Carboniferous period created great stores of fossil fuels: coal, oil, and gas.

### Total Carbon Pool

The total carbon pool, estimated at about 49,000 gigatonnes (1 gigatonne equals 109 tonnes), is distributed among organic and inorganic forms. Fossil carbon accounts for 22 per cent of the total pool. The oceans contain 71 per cent of the world's carbon, mostly in the form of bicarbonate and carbonate ions. An additional 3 per cent is in dead organic matter and phytoplankton. Terrestrial ecosystems, in which forests are the main reservoir, hold about 3 per cent of the total carbon. The remaining 1 per cent is held in the atmosphere, circulated, and used in photosynthesis.

### Addition to Atmosphere

Because of the burning of fossil fuels, the clearing of forests, and other such practices, the amount of  $\text{CO}_2$  in the atmosphere has been increasing since the Industrial Revolution. Atmospheric concentrations have risen from an estimated 260 to 300 parts per million (ppm) in pre-industrial times to more than 350 ppm today. This increase accounts for

only half of the estimated amount of carbon dioxide poured into the atmosphere. The other 50 per cent has probably been taken up by and stored in the oceans. Although terrestrial vegetation may take up considerable quantities of carbon, it is also an additional source of CO<sub>2</sub>.

Atmospheric CO<sub>2</sub> acts as a shield over the Earth. It is penetrated by short-wave radiation from outer space but blocks the escape of long-wave radiation. As air pollution has increased the quantities of CO<sub>2</sub> added to the atmosphere, the shield thickens and more heat is retained, increasing global temperatures in a process known as the greenhouse effect. Although such increases have not yet been great enough to cancel out natural climatic variability, projected increases in CO<sub>2</sub> from the burning of fossil fuels suggest that global temperatures could rise some 2° to 6° C (about 4° to 11° F) in the first decades of the 21st century. This increase would be significant enough to alter global climates and thereby affect human welfare.

### **Nitrogen Cycle**

Nitrogen Cycle, natural cyclic process in the course of which atmospheric nitrogen enters the soil and becomes part of living organisms, before returning to the atmosphere. Nitrogen, an essential part of the amino acids, is a basic element of life. It also makes up 79 per cent of the Earth's atmosphere, but gaseous nitrogen must be converted to a chemically usable form before it can be used by living organisms. This is accomplished through the nitrogen cycle, in which gaseous nitrogen is converted to ammonia or nitrates (salts of nitric acid). The high energies provided by lightning and cosmic radiation serve to combine atmospheric nitrogen and oxygen into nitrates, which are carried to the Earth's surface in precipitation. Nitrogen fixation, the biological process which accounts for the bulk of the nitrogen-conversion process, is accomplished by free-living, nitrogen-fixing bacteria; symbiotic bacteria living on the roots of plants (mostly legumes and alders); cyanobacteria; certain lichens; and epiphytes in tropical forests.

Nitrogen "fixed" as ammonia and nitrates is taken up directly by plants and incorporated in their tissues as plant proteins. The nitrogen then passes through the food chain from plants to herbivores to carnivores in the process known as the food web. When plants and animals die, the nitrogenous compounds are broken down by decomposing into ammonia, a process called ammonification. Some of this ammonia is taken up by plants; the rest is dissolved in water or held in the soil, where micro-organisms convert it into nitrates and nitrites in a process called nitrification. Nitrates may be stored in decomposing humus or leached from the soil and carried to streams and lakes. They may also be converted to free nitrogen through denitrification and returned to the atmosphere.

In natural systems, nitrogen lost by denitrification, leaching, erosion, and similar processes is replaced by fixation and other nitrogen sources. Human intrusion in the nitrogen cycle, however, can result in less nitrogen being cycled, or in an overload of the

system. For example, the cultivation of croplands, harvesting of crops, and cutting of forests have all caused a steady decline of nitrogen in the soil. (Some of the losses on agricultural lands are replaced only by applying energy-expensive nitrogenous fertilizers manufactured by artificial fixation.) On the other hand, the leaching of nitrogen from overfertilized croplands, cutover forestland, and animal wastes and sewage has contributed to water pollution by adding too much nitrogen to aquatic ecosystems, resulting in reduced water quality and the stimulation of excessive algal growth. In addition, nitrogen dioxide poured into the atmosphere from vehicle exhausts and power plants breaks down to form ozone and reacts with other atmospheric pollutants to form photochemical smog.

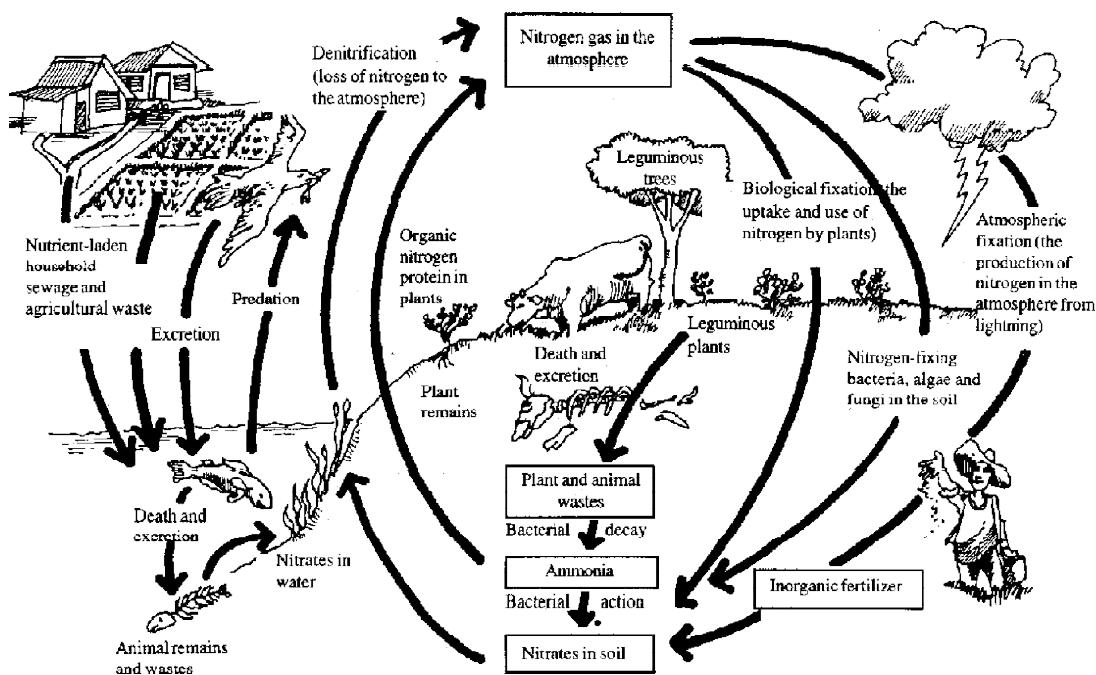


Fig. 5.2. Nitrogen Cycle

### Sulphur Cycle

The sulphur cycle is an example of sedimentary nutrient cycle. The ocean is the principal source of sulphur. Only a few organisms gain their sulphur requirements only in the form of amino acids. Inorganic sulphur is the major source of biologically significant sulphur. Autotrophic plants reduce the sulphur which is incorporated into proteins, sulphur being an essential constituents of certain amino acids. The autotrophs may later be consumed by heterotrophs, and when animals and plants die then bodies are decomposed by

heterotrophic microorganisms such as *Aspergillus*, *Neurospora* etc. The decomposition results in the liberation of hydrogen sulphide. A part of the hydrogen sulphide is then converted into sulphates by microorganisms like *Thiobacillus*. The remaining part of hydrogen sulphide passes into reservoir pool in deep sediments.

Some organic sulphur enters the atmosphere as sulphur dioxide through incomplete combustion of fossil fuels, coal. This is one of the major sources of air pollution today. The oxides of sulphur are normally transitory steps in the cycle. Sulphur is apparently enough to meet the needs of living organisms. It also plays an important role in global climate. Even if the air is moist, clouds do not form readily unless there are nuclei around which water can condense. Dimethyl sulphide is the major source of such nuclei. Therefore, increase or decrease in sulphur emissions can change cloud cover and hence climate. Sulphur emitted by human activities now equals sulphur fluxes, and the increased sulphur cycle is already influencing global climates. The increase in atmospheric concentrations of carbon dioxide has not warned Earth as much during the past century as expected because cloud cover has increased along with increase in atmospheric concentrations of dimethyl sulphide, thus allowing less sunlight to reach Earth.

### Sulfur Cycle

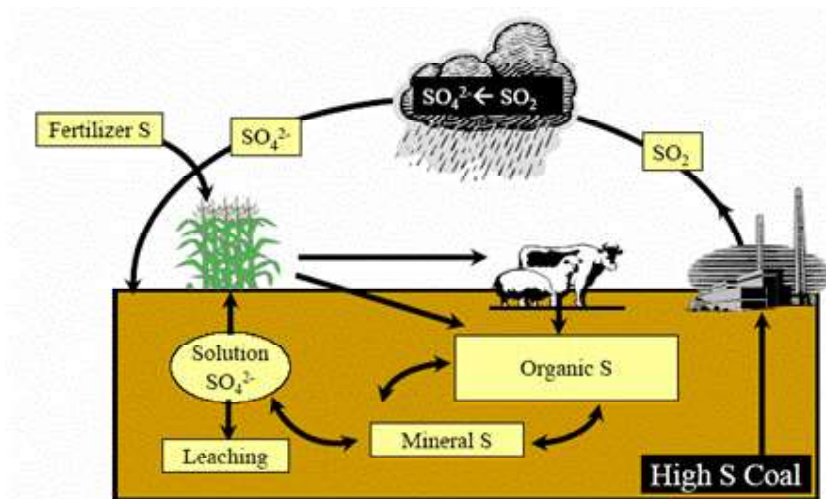


Fig. 5.3. Sulphur Cycle

### Conclusion

In ecology and Earth science, a **biogeochemical cycle** or **nutrient cycle** is a pathway by which a chemical element or molecule moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth. In effect, the element is recycled, although in some cycles there may be places (called *reservoirs*) where the

element is accumulated or held for a long period of time (such as an ocean or lake for water). Water, for example, is always recycled through the water cycle, as shown in the diagram. The water undergoes evaporation, condensation, and precipitation, falling back to Earth clean and fresh. Elements, chemical compounds, and other forms of matter are passed from one organism to another and from one part of the biosphere to another through the biogeochemical cycles.

### SHORT ANSWER

1. What are the material cycles or biogeochemical cycles?
2. What do you understand by total carbon pool?
3. What are the types of material cycles?
4. Differentiate between carbon and sulfur cycle.
5. Explain the chemical reaction of photosynthesis.
6. How many years it takes to build an inch of topsoil?
7. Evaluate man's role in disruption of carbon cycle at local and global level.
8. Discuss the effect of fertilizers and pesticides causing ecological disturbance.
9. How carbon cycle and nitrogen cycle are interlinked?
10. What happens to carbon which is not recycled?

### LONG ANSWER

1. Discuss the Carbon cycle.
2. Explain the Nitrogen cycle.
3. Discuss the importance of Biogeochemical cycles
4. How the pollution can disturb the functioning of material cycles?
5. Explain the sulfur cycle.
6. What is the impact of human activities on our physical and biological environment?
7. What is the reason of "minamata disease"?
8. What are the reasons of disrupting Nitrogen cycle?
9. Discuss the sources of nutrient overloading in lake ecosystem.
10. How the common man can be aware about the importance of biogeochemical cycles?

### TRUE/FALSE

1. Gaseous nutrient cycles are concern with P, S, Hg, Pb and Cd.
2. Total carbon pool is estimated about 49000 gigatonnes.
3. Oceans contain 76% of the world's carbon.

4. Ozone day is observed on September 26<sup>th</sup>.
5. The atmospheric temperature rises up by CO<sub>2</sub> and water vapour.
6. 3% Carbon is in dead organic matter and phytoplankton.
7. Dimethyl sulphide, restrict sunlight to reach Earth.
8. The autotrophs are being consumed by heterotrophs.
9. Fossil carbon accounts for 76 per cent of the total pool.
10. All the carbon compounds are broken down by decomposition.

### **FILL IN THE BLANKS**

1. Biogeochemical cycles are also known as \_\_\_\_\_.
2. Autotrophic plants reduce the \_\_\_\_\_.
3. Sulfur cycle is the example of \_\_\_\_\_ cycle.
4. The total % of Nitrogen in the earth is \_\_\_\_\_%.
5. P,S,Hg, Pb and Cr come under the category of \_\_\_\_\_ nutrient cycle.
6. NO<sub>2</sub> and \_\_\_\_\_ cause the acid rain.
7. Burning of fossil fuels raise the global temperatures up to \_\_\_\_ to \_\_\_\_ °C.
8. Increase or decrease in \_\_\_\_\_ emissions can change cloud cover and climate.
9. Biogeochemical cycle can also called as \_\_\_\_\_ cycle.
10. Hydrogen sulphide is converted in sulphates by microorganisms named \_\_\_\_\_.



## CHAPTER

# 6

## Problems of Drinking Water

### Water Borne Diseases

Today, 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone. Water-borne diseases and water-caused health problems are mostly due to inadequate and incompetent management of water resources. In the urban areas water gets contaminated in many different ways, some of the most common reasons being leaky water pipe joints in areas where the water pipe and sewage line pass close together. Sometimes the water gets polluted at source due to various reasons and mainly due to inflow of sewage into the source. Ground water can be contaminated through various sources and some of these are mentioned below.

**Pesticides :** Run-off from farms, backyards, and golf courses contain pesticides such as DDT that in turn contaminate the water. Leech ate from landfill sites is another major contaminating source. Its effects on the ecosystems and health are endocrine and reproductive damage in wildlife. Groundwater is susceptible to contamination, as pesticides are mobile in the soil. It is a matter of concern as these chemicals are persistent in the soil and water.

**Sewage :** Untreated or inadequately treated municipal sewage is a major source of groundwater and surface water pollution in the developing countries. The organic material that is discharged with municipal waste into the watercourses uses substantial oxygen for biological degradation thereby upsetting the ecological balance of rivers and lakes. Sewage also carries microbial pathogens that are the cause of the spread of disease.

**Nutrients :** Domestic waste water, agricultural run-off, and industrial effluents contain phosphorus and nitrogen, fertilizer run-off, manure from livestock operations, which increase the level of nutrients in water bodies and can cause eutrophication in the lakes and rivers and continue on to the coastal areas. The nitrates come mainly from the fertilizer that is added to the fields. Excessive use of fertilizers cause nitrate contamination of groundwater, with the result that nitrate levels in drinking water is far above the safety levels recommended. Good agricultural practices can help in reducing the amount of nitrates in the soil and thereby lower its content in the water.

**Synthetic organics :** Many of the 100 000 synthetic compounds in use today are found in the aquatic environment and accumulate in the food chain. POPs or Persistent organic pollutants, represent the most harmful element for the ecosystem and for human health, for example, industrial chemicals and agricultural pesticides. These chemicals can accumulate in fish and cause serious damage to human health. Where pesticides are used on a large-scale, groundwater gets contaminated and this leads to the chemical contamination of drinking water.

**Acidification :** Acidification of surface water, mainly lakes and reservoirs, is one of the major environmental impacts of transport over long distance of air pollutants such as sulphur dioxide from power plants, other heavy industry such as steel plants, and motor vehicles.

**Chemicals in drinking water :** Chemicals in water can be both naturally occurring or introduced by human interference and can have serious health effects.

**Fluoride :** Fluoride in the water is essential for protection against dental caries and weakening of the bones, but higher levels can have an adverse effect on health. In India, high fluoride content is found naturally in the waters in Rajasthan.

**Arsenic :** Arsenic occurs naturally or is possibly aggravated by over powering aquifers and by phosphorus from fertilizers. High concentrations of arsenic in water can have an adverse effect on health. A few years back, high concentrations of this element was found in drinking water in six districts in West Bengal. A majority of people in the area was found suffering from arsenic skin lesions. It was felt that arsenic contamination in the groundwater was due to natural causes.

On April 01, 2010 at least 18 babies in several hamlets of Bihar's Bhojpur district have been born blind in the past three months because their families consume groundwater containing alarming levels of arsenic, doctors said. Bihar's Health Minister Nand Kishore Yadav on Wednesday confirmed the cases of blindness in newborns in arsenic-affected blocks of the district but said the cause of blindness was not known. Though more than 16 districts of Bihar have reported arsenic contamination of groundwater sources, Bhojpur emerged on top, with 1,861 parts per billion (ppb) against the World Health Organization's limit of 50 ppb.

**Lead :** Lead pipes, fittings, solder, and the service connections of some household plumbing systems contain lead that contaminates the drinking water source.

**Recreational use of water :** Untreated sewage, industrial effluents, and agricultural waste are often discharged into the water bodies such as the lakes, coastal areas and rivers endangering their use for recreational purposes such as swimming and canoeing.

**Petrochemicals :** Petrochemicals contaminate the groundwater from underground petroleum storage tanks.

**Other heavy metals :** These contaminants come from mining waste and tailings, landfills, or hazardous waste dumps.

**Chlorinated solvents :** Metal and plastic effluents, fabric cleaning, electronic and aircraft manufacturing are often discharged and contaminate groundwater.

### **Pollution in water cause that Water-born Disease**

Pollution in water cause the following Water-borne diseases :

- (a) Bacterial infections Typhoid
- (b) Cholera
- (c) Paratyphoid fever
- (d) Bacillary dysentery
- (e) Viral infections Infectious Hepatitis (jaundice)
- (f) Poliomyelitis
- (g) Protozoan infections Amoebic dysentery

Water-borne diseases are infectious diseases spread primarily through contaminated water. Though these diseases are spread either directly or through flies or filth, water is the chief medium for spread of these diseases and hence they are termed as water-borne diseases.

Most intestinal (enteric) diseases are infectious and are transmitted through faeces waste. Pathogens – which include virus, bacteria, protozoa, and parasitic worms – are disease-producing agents found in the faeces of infected persons. These diseases are more prevalent in areas with poor sanitary conditions. These pathogens travel through water sources and interfuses directly through persons handling food and water. Since these diseases are highly infectious, extreme care and hygiene should be maintained by people looking after an infected patient. Hepatitis, cholera, dysentery, and typhoid are the more common water-borne diseases that affect large populations in the tropical regions.

A large number of chemicals that either exist naturally in the land or are added due to human activity dissolve in the water, thereby contaminating it and leading to various diseases.

**Pesticides :** The organophosphates and the carbonates present in pesticides affect and damage the nervous system and can cause cancer. Some of the pesticides contain carcinogens that exceed recommended levels. They contain chlorides that cause reproductive and endocrinal damage.

**Lead :** Lead is hazardous to health as it accumulates in the body and affects the central nervous system. Children and pregnant women are most at risk.

**Fluorosis :** Excess fluorides can cause yellowing of the teeth and damage to the spinal cord and other crippling diseases. In India, the most common cause of **fluorosis** is fluoride-laden water derived from bore wells dug deep into the earth. Of India's 32 states, 17 have been identified as "endemic" areas for fluorosis, with an estimated 25 million people impacted, and another 66 million "at risk."

**Dental Fluorosis**

India's largest state, suffers from fluorosis, a debilitating disease that damages bones and teeth, research by a voluntary body shows. "The incidence of fluorosis, caused by an excess of fluoride compounds in drinking water, has been rising at an alarming rate in the state". It is estimated that around 25 percent of the rural population in the state is affected. Villagers who consume non-potable water suffer from yellow, cracked teeth, joint pains and crippled limbs and also age rapidly.

**Nitrates** : Drinking water that gets contaminated with nitrates can prove fatal especially to infants that drink formula milk as it restricts the amount of oxygen that reaches the brain causing the 'blue baby' syndrome. It is also linked to digestive tract cancers. It causes algae to bloom resulting in eutrophication in surface water.

**Petrochemicals** : Benzene and other petrochemicals can cause cancer even at low exposure levels.

**Chlorinated solvents** : These are linked to reproduction disorders and to some cancers.

**Arsenic** : Arsenic poisoning through water can cause liver and nervous system damage, vascular diseases and also skin cancer.

**Other heavy metals** : Heavy metals cause damage to the nervous system and the kidney, and other metabolic disruptions.

**Salts** : It make the fresh water unusable for drinking and irrigation purposes. Exposure to polluted water can cause diarrhoea, skin irritation, respiratory problems, and other diseases, depending on the pollutant that is in the water body. Stagnant water and other untreated water provide a habitat for the mosquito and a host of other parasites and insects that cause a large number of diseases especially in the tropical regions. Among these, malaria is undoubtedly the most widely distributed and causes most damage to human health.

**Preventive Measures**

Water-borne epidemics and health hazards in the aquatic environment are mainly due to improper management of water resources. Proper management of water resources has become the need of the hour as this would ultimately lead to a cleaner and healthier environment. In order to prevent the spread of water-borne infectious diseases, people should take adequate precautions. The city water supply should be properly checked and necessary steps taken to disinfect it. Water pipes should be regularly checked for leaks and cracks. At home, the water should be boiled, filtered, or other methods and necessary steps taken to ensure that it is free from infection.

**Fluoride Problem in Drinking Water**

The content of fluoride in drinking water and tooth paste attracts public attention nowadays. On the one hand, fluoride is added to many drinking waters in small quantities to prevent dental caries. On the other hand, fluoride is a carcinogen, a bone seeker and is linked to hip fractures and brittle bones.

Recalling the basics of inorganic chemistry we should keep in mind that among the four best known halogens (chlorine, bromine, iodine, and fluorine) namely fluorine is the most chemically active, being a very strong oxidant. All salts of fluorine are toxic, but some of them more, some less. Sodium fluoride, for example, a common additive to tooth pastes nowadays, a very toxic compound, far more toxic than calcium fluoride salts, is used also as a wood preservative and pesticide.

Research of several investigators during the last 5–6 years has proved that life-long impact and accumulation of fluorides causes not only human skeletal and teeth damage, but also changes in the DNA-structure, paralysis of volition, cancer, etc. IG Farben supplied the German Army with fluorine gas already during World War I. During World War II both sides of the front made plans how to paralyse the volition of war prisoners and population of occupied territories with drinking water fluoridation. Because of the toxicity of fluoride and danger of overdosing, fluoridation of drinking water has been stopped in many countries.

For fluoride consumption by humans 3 mg F/day is a figure that should never be exceeded, and, of course, sodium fluoride in tooth pastes should be replaced with calcium fluorides, which are much less toxic.

The optimum fluoride concentration in drinking water that would decrease dental decay without producing a significant amount of fluorosis. Another study indicated almost twice as many Mongoloid births in Illinois and other areas where the fluoride content in the drinking water is high compared with areas where the fluoride content is low.

What could be an optimum concentration of fluoride in drinking water? Estonian and EU requirements set a limit at 1.5 mg/L. A study in the USA showed that the optimum fluoride concentration in temperate climates is 1.0–1.2 mg/L.

**Sources of fluorine/fluoride exposure include :**

1. Fluoridated toothpaste, and some pharmaceutical medications, some food/beverages.
2. Military exposure to chemical weapons.
3. Exposure to fluoride-containing fumigants and rodenticides, and cigarette smoke.
4. Industrial exposure —including aluminum smelting, glass etching, and some manufacturing processes .
5. fluoridated water, including occupational exposure to sodium fluoride in water treatment, and overexposure to fluoridated water (such as soaking hot tubs, swimming, showers, drinking water, and food products using fluoridated water (such as fruit juices, infant formulas, other beverages).

**Effects of chronic fluoride/fluorine exposure from ingestion, inhalation, or skin absorption, include :**

1. Weight loss, chronic fatigue not alleviated by rest, general weakness, depression.
2. Headaches, bone, joint and muscle pain, muscle spasms.

3. Brittle bones and teeth, tinnitus
4. Anemia, acidosis, reddish spots on skin, slight bleeding from nose lining
5. Blurred vision, dizziness, poor balance, numbness and tingling of extremities
6. Depression, difficulty concentrating, loss of mental alertness, nervousness
7. Excessive thirst, kidney inflammation, frequent urination
8. Nausea, diarrhea, constipation, blood in stools, flatulence, abdominal pain
9. Damage to internal organs, and to cellular biochemistry & thyroid functioning

### **Routes of Entry and Storage**

1. Fluorides can enter the body through inhalation of gases and vapors, through swallowing, and through skin absorption.
2. Fluorides can be stored in bones and teeth, and any tissues of the body

### **How to Neutralize the effect of Fluoride**

During sauna-based detoxification, and during heavy exercise, fluorine appears to mobilize from body stores. In sufficient quantities, such dumping can cause the symptoms of acute fluorine poisoning and have serious consequences. The fluorine re-entering the circulation can cause acidity (possibly hydrofluoric acid or related compound). Several measures have been found helpful adjuncts to sauna detox and general alleviation of fluoride-intoxication symptoms:

1. Avoidance of acidic foods, such as citrus fruits.
2. Large quantities of supplemental calcium carbonate, which not only helps to de-acidify the body, but also binds fluorine —assisting in safe excretion of fluorine, and also helping replenish body calcium stores depleted by fluorine.
3. Ingestion of a tablespoonful of lecithin twice daily, which helps protect nerve sheaths and kidney linings from corrosion/acidity.
4. Deep breathing of clean, fresh air when the body feels acidic and during the detox procedures, to help remove fluorine through respiration, and relieve some of the stress on the kidneys.
5. Ingestion of copious amounts of fluorine-free water, to dilute body concentrations of fluoride and facilitate safe excretion.
6. **Use of *Stellaria spp.*** (common chickweed) as a tea. This plant, a common garden weed which is edible in apparently unlimited quantities without toxic effect, helps soothe inflamed kidneys. It should be gathered from areas free from animal contact and from pesticide/auto exhaust drift. Washed thoroughly, it can then be dried (maintaining color and activity) by placing in open container in a refrigerator, turning gently every day or so until thoroughly dried. It can then be stored in dark containers for a few months. Dose about half to full teaspoon of dried plant

per 1 cup boiling water. Bring to boil, simmer a few minutes, then steep for 15-20 minutes. One or two swallows at a time as desired.

7. The sauna used in detoxification should either be “dry sauna,” or if an Indian-type sweat lodge is used, then fluoride-free water should be used. Steam saunas using tap water may, in fluoride-containing water areas, add to the problem rather than helping to resolve it.
8. Hair loss due to fluoride poisoning (also useful in treatment of organic mercury-related hair loss). After gently washing with “natural” shampoo and rinsing, gently rub into scalp “organic” cold-pressed olive oil to which has been added: a bit of strong nettle (*Urtica sp*, commonly available in health food stores) tea, and dissolved vitamin/mineral supplements as desired (not too much). After rubbing into scalp and hair, wrap head (paper towels, cloth, etc.) for about 20 minutes, then wash out.

## Conclusion

Drinking of water contaminated by human or animal feces, which contains pathogenic microorganisms, causes water borne diseases. In developing countries four-fifths of all the illness are caused by water-borne diseases, with diarrhea being the leading cause of childhood death. Floodwaters can carry with it Raw sewage, Silt, Oil or Chemical wastes and cause diarrhea and dysentery. Infectious diseases caused by pathogenic bacteria, viruses, and protozoa are the most common and wide spread health risk associated with drinking water.

## SHORT ANSWER

1. Discuss the various sources of water borne diseases.
2. What is dental fluorosis?
3. Explain the sources of fluorine exposure.
4. How we can neutralize the effect of fluoride?
5. How cadmium intoxication can be prevented?
6. How much is the chloride content in weak sewage/strong sewage?
7. Why water is more prone to pollution?
8. Draw the chemical structure of fluoride.
9. What are the possible precautions for fluorosis?
10. When the problem of fluorosis firstly reported?

## LONG ANSWER

1. What are the water borne diseases?
2. What is fluorosis?

3. Discuss the various aspects of fluoride problems in drinking water.
4. How can be people make conscious about fluoride pollution?
5. Discuss the possible remedies for fluoride pollution.
6. How to aware people about the fluoride pollution?
7. Is there any replacement of fluoride using in toothpaste?
8. How fluoride is mixing with drinking water?
9. Is human fertility can be affected by fluoride pollution?
10. What are the possible remedies for the water borne diseases?

### TRUE/FALSE

1. Toothpaste is the one major source of fluoride in water.
2. Safe fluoride consumption by human is 5 mg/day.
3. Chronic fluoride concentration cause white spot on skin.
4. NEERI is the environmental planning organization.
5. Decomposition of domestic waste is known as thermal pollution.
6. Fly ash is produced by CO.
7. Methane blocks the Ultra-violet radiation.
8. The catstrophy is due to glacier melting.
9. World environment is on 5<sup>th</sup> June.
10. The headquarter of environmental education is at Jodhpur.

### FILL IN THE BLANKS

1. Total \_\_\_\_\_ million Indians are affected by water borne disease.
2. Increased level of nutrients in lake is called \_\_\_\_\_.
3. POPs stands for \_\_\_\_\_.
4. Pesticides present in water can damage the \_\_\_\_\_ system of human.
5. Highest number of patients of fluorosis are found in \_\_\_\_\_.
6. Environmental awareness develops \_\_\_\_\_ aspects.
7. Carbon monoxide is \_\_\_\_\_ and \_\_\_\_\_.
8. \_\_\_\_\_ is the main polluting agent of environment.
9. Rise in global temperature can cause floods in low \_\_\_\_\_.
10. \_\_\_\_\_ is the main source of fluoride dispersal.



## CHAPTER

# 7

## Energy and Alternate Source of Energy

The word energy has an everyday meaning and a scientific one. The everyday meaning is force, vigor, power, strength, action skills, or determination, decision in everything you do.

### Definition of Energy

At the actual level of knowledge and technical development, it is considered that the Universe which surrounds us exists under two forms: substance and force. Substance is characterized by two fundamental aspects: mass and energy. Mass is the measure of inertia and gravitation, and energy is the scalar measure of substance movement. The word energy is well known, but the concrete content of the notion is not so popular or rigorously analyzed, because of some subtle particularities, characteristic to certain forms of energy. The most general definition presents energy as measure of substance movement. This definition is correct, but it is not very clear, as substance is characterized by more forms of movement.

### Energy

Energy is the measure of a physical system. It defines the quality of the changes and processes which take place in the Universe, beginning with movement and finishing with thinking. The unity and the connection between the movement forms of substance, their lively capacity of mutual transformation, allowed the measuring of different forms of substance through a common aspect: energy.

### Types of Energy

The name of energy forms is related to :

1. The way energy is perceived (for example: mechanical energy, electrical energy, energy of light)
2. What carries the energy (for example: thermal energy)
3. The origins of energy (for example: nuclear energy, hydraulic energy, wind energy, geothermal energy, and solar energy).

Some general principles can be reminded :

1. Energy is mathematical abstraction, a measure of movement within moving forms changing phenomena.
2. The energy which is available is not always under the form expected. In order to obtain the form you want, you must proceed to conversion. Usually, not all the energy available can be changed into another form of energy.
3. The total amount of energy does not change in the case of any process of moving forms – this is the **energy conservation law**. This law permits to deduce how a changing system works, if we know the mathematical expressions of different forms of energy.
4. As energy can not be created or destroyed, the sum of energies which enter a process must be equal with the sum of energies which result from the process.

### **Conventional and Non-conventional Source**

Energy is the most critical component of our environmental requirements. Stocks of conventional energy sources like fossil fuels are rapidly dwindling. Rapid advancement in science and technology, improvement in the standard of living of people and escalating environmental pollution have necessitated the search for newer, safer and cheaper sources of energy. Energy sources can be broadly classified into two groups, viz., non-renewable and renewable.

Non-renewable energy resources include various fossil fuels and nuclear energy. The important fossil fuels are petroleum products, natural gas, coal and lignite. Nuclear energy is considered inexhaustive, however the reserves of uranium that is used for fission in nuclear reactors is limited and its stocks are rapidly diminishing. Use of fossil fuels as source of energy has serious environmental consequences. They are the main source of air pollution. Greenhouse gases released from the use of fossil fuels are responsible for global warming. In addition they are responsible for acid rains and oil spills with consequent environmental hazards. Dependence on nuclear reactors for energy can lead to radiation hazards as experienced in Long Island and Chernobyl incidents. These experiences have necessitated search for safer and at the same time cheaper renewable energy sources.

Renewable energy resources are constantly regenerated by natural processes and hence they are inexhaustible or can be used indefinitely. They are eco-friendly, causing lesser environmental impact compared to non-renewable sources. One drawback is that present day technologies are inadequate to regenerate energy from renewable resources at a cost cheaper than those for nonrenewable sources. However, with further advancement in technology, the use of renewable energy resources will soon overtake nonrenewable sources. Among the renewable sources solar energy is the most important one. The other sources are hydropower, wind power, geothermal energy, ocean wave energy and tidal power.

### Hydro-Electric Power (Hydro Power)

Flowing water has energy in it. The energy present in the flowing water is due to its motion. The device commonly used for obtaining energy from flowing water is called water wheel. The moving water rotates the water wheel, and this rotating water wheel can be made to turn a machine. Electricity is generation from flowing water. These days, the energy of naturally flowing water in high rivers is stored behind dams as potential energy and then used to produce electricity. The electricity generating by using the energy of flowing water is called Hydro electric power.

### Generation of Hydro-electricity

The rain or river water is stored at a higher level in a reservoir and the impounded water acts as a source of stored energy. The stored water is released by opening controlled-valves (iron gates) in the dam to provide a constant flow of water through turbines which in turn drive generators to hydro-electricity.

### Advantages of Hydro-electricity

- (i) The process, is 80-90 percent efficient. 80-90 percent mechanical energy of water is converted into electrical energy.
- (ii) The hydro-electricity generation can be easily regulated by opening or closing the control valves.

### Limitations of Water Energy

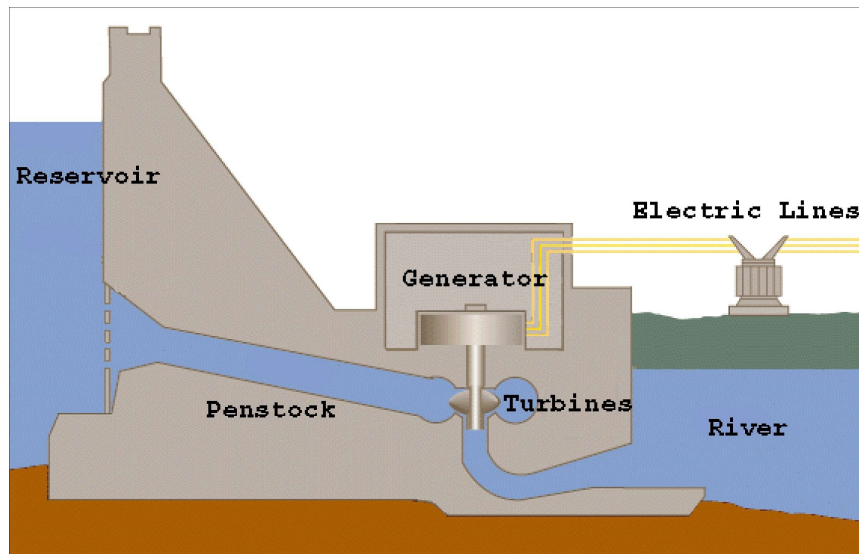


Fig. 7.1. The Dam's Layout

We know that water falls and flowing rivers are not everywhere. So, an important limitation of water energy is that flowing water or falling water is not available in plenty everywhere to turn wheels and run the turbines. It is available in plenty only near a flowing river or a high dam. On the debit side, hydroelectric schemes may demand enormous capital investment and their environmental impact can be heavy.

### **Hydro Electricity Generation in India**

The share of hydro projects in total power generating capacity started delivering in the seventies. It was 37.3 percent in 1937 improved to 41 percent in 1961, reached a high of 46 percent in 1969 and now is only 26.4 percent.

A hydro project's greatest advantage is that it can be switched off and on whenever necessary. It is cheapest among the various sources, has no fuel cost component and is free from operating cost escalation. They environmental friendly as compare to other energy sources.

### **Solar Energy**

It is the source of energy driven by thermonuclear fusion reactions deep in sun's core. The earth receives 170 trillion kilowatts of radiation from the sun (eight days of sunshine is equal to all the available sources of energy in the world put together. It is thus apparent that if irrigation of only 1 percent of the earth's surface could be converted into useful energy with 10 percent efficiency, solar energy could fulfill needs of entire population.

### **Device based on the Solar Energy**

The various devices which are being used to convert the solar energy into usable forms are: solar cooker, solar heater and solar power plants etc. We shall discuss few of these appliances :

**(a) Solar Cooker :** A solar cooker is a device which is used to cook food by utilizing the energy radiating by the sun. A solar cooker consists of an insulated metal box or wooden box, which is painted all black from inside. There is thick glass sheet cover over the box, and a plain mirror reflector is also attached to the box as shown in Fig. 9. The food to be placed in a metal container and the container is kept in the box and covered with glass sheet. The food container is painted black from outside. In order to cook food, the solar cooker is kept in the sunlight and its reflector is adjusted in such a way that a strong beam of the sunlight falls over the cooker top.

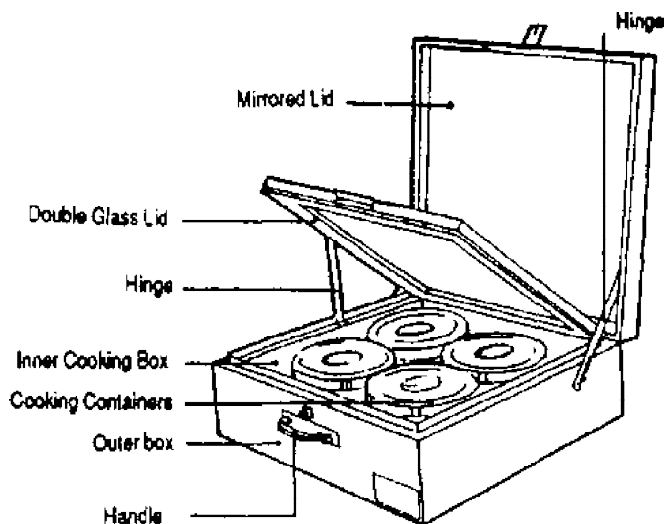


Fig. 7.2. Solar cooker

**(b) Solar Heater:-** A solar heater is a device to supply hot water by using solar energy (Fig.10). A solar water heater can be installed on top of flat-roofed buildings and provide domestic hot water throughout the year.

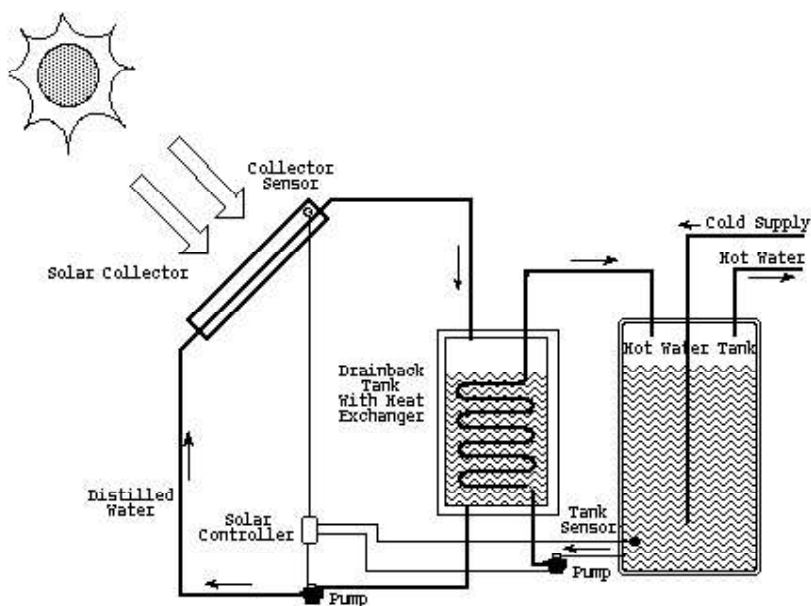


Fig. 7.3. Solar Heater

**Utilization of Solar Energy in India**

India gets plentiful sunshine for the at least 250-300 days/year. In south and central India the annual average daily incidence of solar energy is 4.6 kwh/m<sup>2</sup> with the maximum exceeding 7.1 kwh/m<sup>2</sup>. Therefore, solar energy offers an attractive solution to some of the energy problems in India.

**Utilization of Solar Energy for various Purposes**

- (i) National Physical laboratory, Delhi has developed a solar water pump at 1 kw rating called Abhimanyu.
- (ii) A solar photovoltaic water pumping station has been developed by Central Electronics Ltd., Sahibabad. In this system the sunlight is directly converted into electricity and the energy is used to run an electric motor pumpset.
- (iii) The government of India has introduced box type solar cookers with heavy subsidies.

**Advantages of Solar Energy**

An important advantage of solar energy is that it does not cause any pollution. Moreover, it is available in abundance in a hot country like India and free of cost. An important limitation of solar energy is that it is not available in sufficient amount all the time. The supply of the solar energy is reduced during rainy season and during winter months.

**Uses of Solar Energy**

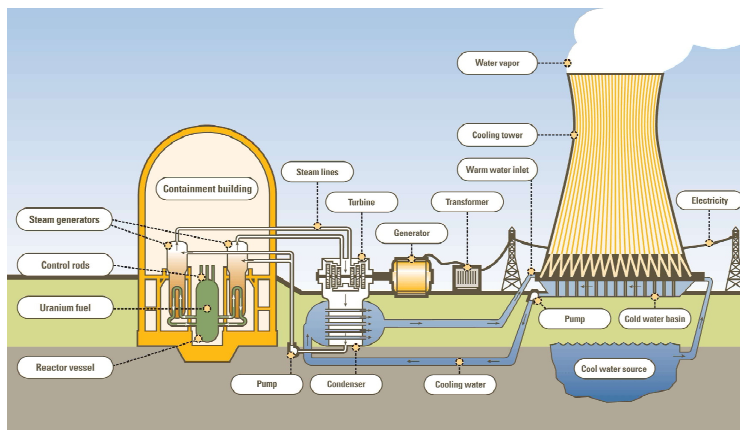
- (i) Solar energy is used for cooking food. This is done by using solar cooker.
- (ii) Solar energy is used for heating water supply in big buildings like hotels. It is done by using solar heaters.
- (iii) Solar energy is used for producing electricity needed in space satellite, and to run watches and calculators by solar cells.
- (iv) Solar energy is used for the production of large scale electricity in solar power plants.
- (v) Solar energy is used to melt and forge metals in solar furnaces.

**Nuclear Energy**

Nuclear energy is quite a benign source, mainly because of the extreme care that is taken during design, construction and operation of the nuclear power plants. Nuclear fission has established itself as one of the potential solutions for this major problem. India has already gained considerable experience and expertise in all aspects of nuclear fuel cycle which includes :

- Uranium mining
- Fabrication of fuel
- Design
- Construction and operation of nuclear plant
- Reprocessing of the spent fuel.

**Nuclear energy in India:** In the context of the energy science of our country nuclear power needs to complement the other sources of energy. India today has five nuclear power reactors in operation. Two at Tarapur (Maharashtra) and two at Kota (Rajasthan) and one at Kalpakkam (Tamil Nadu) with a combined installed capacity of about 1,095 MW representing about 2.5 percent of the total power capacity in the country. Five more units are under construction at Kalpakkam, Nerora (U.P.) and Kakrapara (Gujarat).



**Fig. 7.4. Nuclear Power Plant**

The atmospheric pollution from nuclear power plant during normal operations would be solely due to release of radioactive effluents. Several engineered safety features are provided to prevent any accident and mitigate the consequence should it occurs.

As a matter of abundant caution of site, emergency plans are also worked out for the unlikely event of an accident. Work on high level radioactive waste management relating to fuel reprocessing and also decommissioning of nuclear power reactors are continuing world over and current methods and processes for the same will evolve further and be improvised. All efforts are being made to improve the operating performance of our nuclear power stations.

The future role of nuclear power cannot be underrated in the Indian scene in the context of continuously evolving safety features, high growth rate of electricity needs and likely future development which may limit the burning of coal due to possible greenhouse effect.

### **Biomass and Biogas**

A variety of biological systems can be used for the production or conservation of energy other than as food. They may be classified into :

- (a) Photosynthesis by which solar energy is converted into carbohydrates such as cellulose or sugar.

- (b) Anaerobic fermentation by which plant biomass may be converted by microorganisms into alcohol.
- (c) Enzymatic breakdown or digestion of biomass with the production of methane gas.

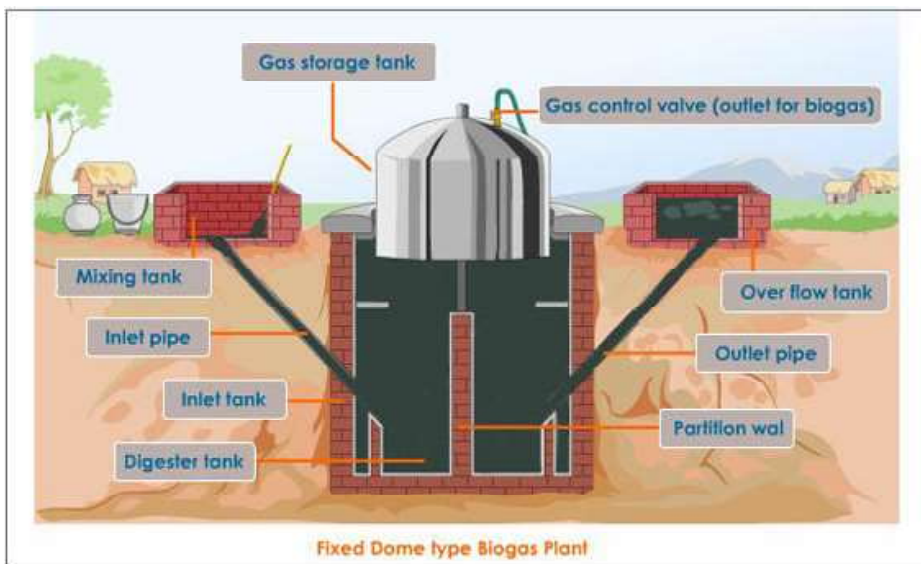
**Biomass :** It is the waste material of living objects. It includes cattle dung, wood, sewage, agricultural wastes or crop residues like bagasse or rice husk.

Biogas plants in India:

Two types of biogas plants are used in our country to produce biogas. In these plants cattle dung or *gobar* is used, so they are called gobar gas plants in our villages. The two types of biogas plants being used are :

- (a) Fixed dome type biogas plant,
- (b) Floating gas holder type biogas plant

**(a) Fixed dome type biogas plant :** Fixed dome type biogas plant is having a well shaped underground tank called **digester**, which is made of bricks and a high dome shaped roof also made of bricks and cement. The dome of the digester tank acts as a holder or storage tank for the biogas. There is a gas outlet at the top of the dome having a valve.



**Fig. 7.5. Fixed dome type biogas plant**

Cattle dung and water are mixed in equal proportions in the mixing tank to prepare the **slurry**. This slurry and the water get fed into the digester tank through the inlet chamber. The digester gets filled with dung slurry upto the cylindrical level, the dome being left free for the collection of biogas. It takes about 50 to 60 days for the new gas plant to become operative. During this period, the cattle dung undergoes fermentation



by anaerobic bacteria the presence of water with the gradual evolution of biogas. This biogas starts collecting in the dome. As more and more biogas gets collected in the dome it exerts pressure on the slurry in the digester tank and forces the spent slurry to go into overflow tank through the outlet chamber. This spent dung slurry left after the withdrawal of biogas is rich in nitrogen and phosphorus compounds and hence forms good **manure**. This biogas is also used to run engines and for streets lighting.

**(b) Floating gas holder type biogas plant :** It differs from the fixed dome type gobar gas plant in the construction of the gas holder. The dome in it is mobile. As more and more biogas is produced the slides up. The floating gas holder type biogas plant is more expensive because it uses a gas holder drum made of steel. Moreover, defects in the welding of gas holder and corrosion of steel can lead to leakage of biogas.

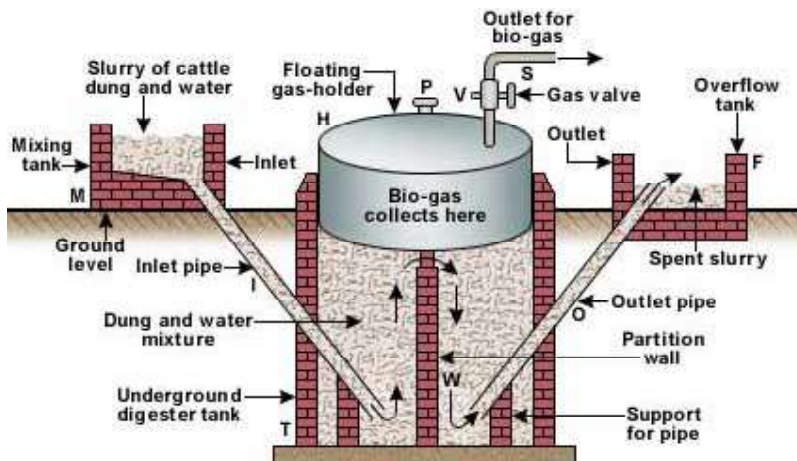


Fig. 7.6. Floating gas-holder type bio-gas plant

### Uses of Biogas

1. Biogas is used for the cooking food. When biogas is burned in a gas stove, it produces a lot of heat. This heat finds use for cooking food and other domestic heating purpose. Biogas is a good domestic fuel because of the following reasons :

- Biogas burns without smoke and hence does not cause any pollution.
- Biogas is having a high calorific value. That is, biogas produces a large amount of heat per unit mass.
- Biogas is very clean fuel and convenient to use.
- There is no storage problem for biogas as it is supplied by pipes directly from the gas plant.
- Biogas is cheaper than most common fuels.

2. Biogas finds use as fuel to run engines. At many places, the engines of water pumping sets used for irrigation are run on bio-gas, instead of diesel.
3. Bio gas also finds use for the streets-lighting.

## **Fossil Fuel**

**Fossil fuels** are fuels formed by natural resources such as anaerobic decomposition of buried dead organisms.

### **Origin of Fossil Fuel**

The age of the organisms and their resulting fossil fuels is typically millions of years, and sometimes exceeds 650 million years. Fossil fuels are formed by the anaerobic decomposition of remains of organisms including phytoplankton and zooplankton that settled to the sea (or lake) bottom in large quantities under anoxic conditions, millions of years ago. Over geological time, this organic matter, mixed with mud, got buried under heavy layers of sediment. The resulting high levels of heat and pressure caused the organic matter to chemically alter, first into a waxy material known as kerogen which is found in oil shales, and then with more heat into liquid and gaseous hydrocarbons in a process known as catagenesis.

There is a wide range of organic, or hydrocarbon, compounds in any given fuel mixture. The specific mixture of hydrocarbons gives a fuel its characteristic properties, such as boiling point, melting point, density, viscosity, etc. Some fuels like natural gas, for instance, contain only very low boiling, gaseous components. Others such as gasoline or diesel contain much higher boiling components.

Terrestrial plants, on the other hand, tend to form coal and methane. Many of the coal fields date to the Carboniferous period of Earth's history. Terrestrial plants also form type III kerogen, a source of natural gas.

### **Composition of Fossil Fuels**

The fossil fuels, which contain high percentages of

- Carbon,
- Coal,
- Petroleum,
- Natural gas.

Fossil fuels range from volatile materials with low **Carbon: Hydrogen** ratios like methane, to liquid petroleum to nonvolatile materials composed of almost pure carbon, like anthracite coal. Methane can be found in hydrocarbon fields, alone, associated with oil, or in the form of methane clathrates. It is generally accepted that they formed from the fossilized remains of dead plants and animals by exposure to heat and pressure in the Earth's crust over millions of years.

### **Importance of Fossil Fuel**

Fossil fuels are of great importance because they can be burned (oxidized to carbon dioxide and water), producing significant amounts of energy per unit weight. The use of coal as a fuel predates recorded history.

It was estimated by the Energy Information Administration that in 2007 primary sources of energy consisted of petroleum 36.0%, coal 27.4%, natural gas 23.0%, amounting to an 86.4% share for fossil fuels in primary energy consumption in the world. Non-fossil sources in 2006 included hydroelectric 6.3%, nuclear 8.5%, and others (geothermal, solar, tide, wind, wood, waste) amounting to 0.9 percent.

Coal was used to run furnaces for the melting of metal ore. Semi-solid hydrocarbons from seeps were also burned in ancient times, but these materials were mostly used for waterproofing and embalming.

Commercial exploitation of petroleum, largely as a replacement for oils from animal sources (notably whale oil), for use in oil lamps began in the nineteenth century.

Natural gas, once flared-off as an unneeded byproduct of petroleum production, is now considered a very valuable resource.

Heavy crude oil, which is much more viscous than conventional crude oil, and tar sands, where bitumen is found mixed with sand and clay, are becoming more important as sources of fossil fuel. Oil shale and similar materials are sedimentary rocks containing kerogen, a complex mixture of high-molecular weight organic compounds, which yield synthetic crude oil when heated (pyrolyzed). These materials have yet to be exploited commercially. These fuels can be employed in internal combustion engines, fossil fuel power stations and other uses.

### **Impact of Fossil Fuels on the Ecosystem**

Fossil fuels are non-renewable resources because they take millions of years to form, and reserves are being depleted much faster than new ones are being made. The production and use of fossil fuels raise environmental concerns. A global movement toward the generation of renewable energy is therefore under way to help meet increased energy needs.

The burning of fossil fuels produces around 21.3 billion tonnes (21.3 gigatonnes) of carbon dioxide (CO<sub>2</sub>) per year, but it is estimated that natural processes can only absorb about half of that amount, so there is a net increase of 10.65 billion tonnes of atmospheric carbon dioxide per year (one tonne of atmospheric carbon is equivalent to 44/12 or 3.7 tonnes of carbon dioxide). Carbon dioxide is one of the greenhouse gases that enhances radiative forcing and contributes to global warming, causing the average surface temperature of the Earth to rise in response, which most climate scientists agree will cause major adverse effects.

## Hydrogen as Alternate Sources of Energy

Hydrogen can be considered as a clean energy carrier similar to electricity. Hydrogen can be produced from various domestic resources such as renewable energy and nuclear energy. In the long-term, hydrogen will simultaneously reduce the dependence on foreign oil and the emission of greenhouse gases and other pollutants.

### What is Hydrogen?

Hydrogen can be considered as the simplest element in existence. Hydrogen is also one of the most abundant elements in the earth's crust. Hydrogen as a gas is not found naturally on Earth and must be manufactured. This is because hydrogen gas is lighter than air and rises into the atmosphere as a result. Natural hydrogen is always associated with other elements in compound form such as water, coal and petroleum.

Hydrogen has the highest energy content of any common fuel by weight. On the other hand, hydrogen has the lowest energy content by volume. It is the lightest element, and it is a gas at normal temperature and pressure.

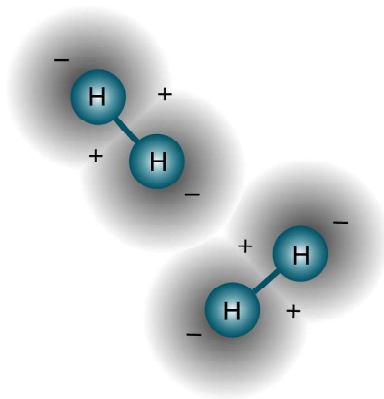


Fig. 7.7. Hydrogen Molecule

### Hydrogen as an Energy Carrier

Hydrogen is considered as a **secondary source of energy**, commonly referred to as an energy carrier. Energy carriers are used to move, store and deliver energy in a form that can be easily used. Electricity is the most well-known example of an energy carrier.

Hydrogen as an important energy carrier in the future has a number of advantages. For example, a large volume of hydrogen can be easily stored in a number of different ways. Hydrogen is also considered as a high efficiency, low polluting fuel that can be used for transportation, heating, and power generation in places where it is difficult to use electricity. In some instances, it is cheaper to ship hydrogen by pipeline than sending electricity over long distances by wire.

### Hydrogen as a Future fuel

In the future, hydrogen will join electricity as an important energy carrier, since it can be made safely from renewable energy sources and is virtually non-polluting. It will also be used as a fuel for

- ‘**zero-emissions**’ vehicles,
- To heat homes and offices,
- To produce electricity,
- To fuel aircraft.

Hydrogen has great potential as a way to reduce reliance on imported energy sources such as oil. Before hydrogen can play a bigger energy role and become a widely used alternative to gasoline, many new facilities and systems must be built.

In an age of increasing fossil fuel prices, uncertainty of energy supplies and concern over the effect of rising carbon dioxide levels in the atmosphere, the role of hydrogen fuel as an alternative energy source is being re-examined.

### Plentiful Supply of Hydrogen

Hydrogen is the most common element in the universe. On Earth, hydrogen is the third most abundant element. However this hydrogen does not exist as the pure element, but as part of other compounds, mainly water and fossil fuels.

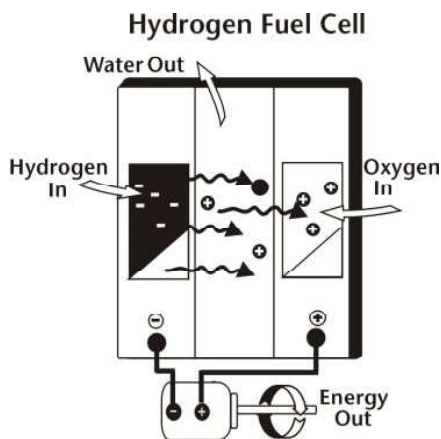
### Hydrogen as a clean Fuel

Hydrogen burns cleanly, producing little or no harmful emissions or CO<sub>2</sub>.

- It has the highest energy content per unit of weight of any known fuel.
- Hydrogen can be produced from abundant domestic resources including natural gas, coal, biomass, and even water.
- When burned in an engine, hydrogen produces effectively zero emissions; when powering a **fuel cell**, its only waste is water.

### Hydrogen Fuel Cell

Fuel cells directly convert the chemical energy in hydrogen to electricity, with pure water and heat as the only byproducts. Hydrogen-powered fuel cells are not only pollution-free, but a two to three fold increase in the efficiency can be experienced when compared to traditional combustion technologies is ideal, producing little or no emissions, with a plentiful supply available. But hydrogen produced by conventional means is not renewable or carbon neutral. Wind power is a totally renewable energy source with no greenhouse gas emissions, but due to its unpredictability, has problems integrating with national grids. Combined together, wind and hydrogen can cancel out their inherent defects and be an effective tool in the battle against carbon dioxide and global warming.



**Fig. 7.8. Hydrogen Fuel Cell**

Fuel cells can power almost any portable devices that normally use batteries. Fuel cells can also power transportation such as vehicles, trucks, buses, and marine vessels, as well as provide auxiliary power to traditional transportation technologies. Hydrogen can play a particularly important role in the future by replacing the imported petroleum we currently use in our cars and trucks.

## Conclusion

There are a number of alternative sources of energy and environmentally friendly fuels available to combat the damage to the environment caused by Fossil Fuels.

Fossil Fuels such as coal and gasoline provide most of the energy needs of the world today, but because of their diminishing reserves, high prices and most importantly, their damaging effect on the environment, alternative sources of energy and environmentally friendly fuels are now being developed. According to the U.S. Department of Energy, "There are more than a dozen alternative and advanced fuels in production or use today." From the perspective of protecting the environment, alternative fuels and alternative sources of energy usually fall under seven broad headings.

- Biofuels
- Natural Gas
- Wind Energy
- Hydroelectric Power
- Solar Energy
- Hydrogen
- Nuclear Energy

**SHORT ANSWER**

1. Give the definition of energy.
2. Discuss the importance of solar energy.
3. Discuss the impact of fossil fuel.
4. What do you know about the hydrogen fuel cell?
5. Discuss the conventional and non-conventional energy sources.
6. Describe the components of atom.
7. Describe the various laws of thermodynamics.
8. Write a note on the productivity of earth.
9. What is detritus food chain?
10. Draw the diagram of solar cooker.

**LONG ANSWER**

1. What do you know about hydro-power?
2. Discuss the nuclear energy and utilities of it.
3. Explain biomass and biogas in detail.
4. Can hydrogen become the alternate source of energy? Prove it.
5. Discuss the need of energy for the human life.
6. How the hydrogen is energy carries? Prove.
7. Draw the labeled diagram of Hydrogen fuel cell.
8. How the hydrogen is produced?
9. Discuss the components of fossil fuel in detail.
10. Describe the floating gas holder type biogas plant.

**TRUE/FALSE**

1. Hydrogen fuel cell converts chemical energy into mechanical energy.
2. Average daily incidence of solar energy is  $4.6 \text{ kWh/m}^2$ .
3. Biogas burns with smoke.
4. Fossil fuel were formed 350 millions year ago.
5. Hydrogen has lowest energy content by volume.
6. Solar cookers are very heavy in weight.
7. Hydrogen fuel cells release CO.

8. Hydrogen is the lightest element on earth.
9. Floating gas holder type biogas plant use  $\text{CaCO}_3$ .
10. One nuclear plant is situated at Kota.

### **FILL IN THE BLANKS**

1. Waste material of living objects is called as \_\_\_\_\_.
2. Non-renewable energy resources includes \_\_\_\_\_ & \_\_\_\_\_ energy.
3. In dams mechanical energy has been converted into \_\_\_\_\_ energy.
4. The earth receives \_\_\_\_\_ trillion kilowatts of sun radiation.
5. Nuclear power reactors in India are situated at \_\_\_\_\_, \_\_\_\_\_ & \_\_\_\_\_.
6. Solar furnace is run on \_\_\_\_\_ energy.
7. Bio-fuel can become the \_\_\_\_\_ fuel.
8. The earth receives \_\_\_\_\_ trillion kilowatts of radiation from the sun.
9. Energy sources can be classified into, \_\_\_\_\_ and \_\_\_\_\_ resources.
10. The energy of sun is called as \_\_\_\_\_ energy.



## CHAPTER

# 8

## Environmental Pollution

Today's major environmental problem is pollution. It is the greatest threat posed to humanity and even to the whole biosphere. *Pollution* can be defined as any undesirable change in the physico-chemical and biochemical properties of the environment. All those substance which cause pollution are called *Pollutants*. Pollution adversely affects us as well as other species. The use of more and more fertilizer and pesticides to increase food production leads to water pollution and the concentration of poison in the food chain. Human waste accumulates in incredible amounts and becomes a source of further pollution, as do industrial wastes and the wastes from burning fossil fuels. The decomposition process results in the production of harmful gases. Many organisms produce toxins. The pollution of various resources has gone to such an extent that we are unable to breathe fresh air and to drink fresh water. Thus pollution is undoubtedly the most important limiting factors for humans. It is difficult to put a price tag on the cost of pollution, but it is clear that pollution places a burden on human society from:-

1. the loss of resources owing to unnecessarily wasteful exploitation,
2. the cost of abating and controlling pollution and
3. the cost of human health.

### Kinds of Pollutions

There are several kinds of pollutions which pollute the environment and the different parts of the environment as given below:

- (i) Biological air pollution by the biological pollutants including a wide range of air borne substance like micro organisms, moulds, dust, pollen etc.
- (ii) Chemical air pollution primarily results from combustion sources such as power plants and heating equipments from exhaust of automobiles. Besides oxides of nitrogen, sulphur etc. resulting from such combustion, airborne toxic metals like lead, mercury, cadmium and arsenic are also present in the atmosphere.

- (iii) Physical aspects of pollution relate to noise pollution, radiation hazards.
- (iv) Water pollution involves uncontrolled disposal of sewage and liquid waste resulting from industrial waste containing a variety of pollutants and the usage of insecticides, and herbicides.

### **Water Pollution**

Water in nature, is present in three forms **(a) atmospheric moisture (b) precipitation** and **(c) soil water**. The precipitation or the rainfall is the chief source of soil moisture. Water covers about 75 percent of our planet. Water pollution is an addition of foreign substance (organic, inorganic, biological or radiological) to water, or a change in its physical property (Temperature) that constitutes a health hazard or otherwise make it unfit for us. Normally water is never pure in chemical sense. It contains impurities of various kinds dissolved as well as suspended. These include dissolved gases ( $\text{H}_2\text{S}$ ,  $\text{CO}_2$ ,  $\text{NH}_3$  and  $\text{N}_2$ ), dissolved minerals (Ca, Mg, Na salts), suspended matter (clay, slit, sand) and microbes.

**Reasons of water pollution :** Man is the main reason of water pollution. Some pollution occurs naturally too. Soil particles enter water by erosion, minerals dissolved in water from rocks and soil, animal wastes and dead parts of plants. Decaying of organic matter also pollutes water.

Sources of water pollution :

- (i) Industrial effluents
- (ii) Sewage and Domestic waste
- (iii) Industrial waste
- (iv) Heat
- (v) Silt
- (vi) Agricultural water pollution
- (vii) Radio-active waste

**(i) Industrial Effluents :** A wide range of both, inorganic and organic pollutants are present in effluents from breweries, textiles, dying, paper and pulp, steel industries and mining operations etc. Industrial wastes released into water contain metallic wastes such as cadmium, lead, arsenic, zinc, copper, chromium, mercury and D.D.T. All these materials can prove harmful to the health. Concentration of the toxic materials increase at each trophic level of a food chain. This is called Biomagnification or biological concentration.

**(ii) Sewage and domestic waste :** About 75 percent of water pollution is caused by sewage and domestic wastes. Humans have always dumped sewage in the rivers and other bodies of water where it would be carried away and disperse. Domestic swage contains decomposable organic matter with depleted oxygen. The amount of oxygen consumed in biological processes involving degradation of organic matter is termed BOD

(Biological oxygen Demand) expressed in mg/l. The decomposed materials eventually become nutrients that plant use. The addition of human wastes to water introduce into the ecosystem a large variety of micro-organisms, many of which cause human diseases as cholera, typhoid and parasitic infection. With the increase in the human populations, the amount of sewage become too great to be processed by aquatic ecosystem. Not only did water become unfit to drink, it became foul and bed smelling. As the amount of organic matter increases in water, the micro-organisms that use the nutrients in it rapidly increasing in number. The inorganic nutrients released by decomposition serve as nutrients for algae, they too reproduce rapidly and use more and more of the available oxygen. Eventually there is insufficient oxygen to support the aerobic organisms in the ecosystem and they die. Their bodies contribute to the organic mass and further complicate the situation. Eventually only the anaerobic microorganisms survive. Many produce methane gas and  $H_2S$  to give foul smell.

**(iii) Industrial waste :** water pollution is also caused by the industrial plants releasing their organic and inorganic waste out. The non usable chemicals are usually dumped in the water as a mean of getting rid of them. The toxicity of these industrial pollutants to aquatic organisms like fishes is variable but all of them contaminate the aquatic environment to a greater or lesser extent and some accumulate on the bottom of the water course and poison the bottom organisms. In this way they reduce the foods for some kinds of fishes. The industries whose trade waste are effluents play major role in the pollution of water include paper and pulp, textile, sugar and rubber etc. in many cases the release of effluent water and the relative temperature rise cause growth of sewage fungus.

**(iv) Heat :** various industrial process may utilize water for cooling, and the resultant warm water has often been discharged into streams or lakes. As the solubility of water is dependent upon temperature, this also reduce the dissolved oxygen contents of water, there by affecting the aquatic life. This is also called the **Thermal pollution**. Most of the aquatic life are very sensitive to temperature fluctuations and cannot adjust rapid temperature change.

**(v) Silt :** sometimes the intensive agriculture and earthmoving for construction projects increase the production of silt in streams and lakes. This load of particular matter cuts down on primary productivity by decreasing the depth of light penetration. Silt may also interrupt or prevent the reproduction of edible fishes.

**(iv) Agricultural water pollution :** Agriculture waste include the pesticides that are sprayed on the crops, as well as sediment, fertilizers and plants and animal debris that are carried into water ways during the periods of rainfall or as runoff and during the irrigation of the farmland. A remarkably large number of pesticides have come into widespread use in recent years. many of these compounds have been not only non-biodegradable but are also only slightly soluble in water. Consequently, when sprayed on cropland they remain in the soil for the long period of time. During the periods of rainfall or when the crops irrigated, they tend to be carried, as suspended particles, into surface, marine and groundwater systems.

**(vii) Radio-active waste :** Today man is using various types of atoms and radio isotopes for preserving food, powering industry and fueling transport. Their waste affect the aquatic system to a very great extent. The cause ionization of various body fluids, chromosomal aberrations and gene mutations, thus affecting man through food chain.

**Pollution in the Sea water :** Everything that is carried away by rivers ultimately goes in seas. This gives rise to pollution by sewage, garbage, agricultural waste, fungicides, pesticides and heavy metals, by discharging of oils and petroleum products and by dumping of radioactive waste into sea. The pollutants get dispersed by turbulence and ocean currents, in the food chain components.

Most probably the most serious pollutant has been the oil, especially when afloat on the sea. Much of the petroleum products are shipped by sea and any spill as a consequence of accidents, deliberate discharge of oil-polluted waste water, can cause serious pollution problem. Oil in the sea has been a serious threat to marine life including fish, birds and algae.

Major cause of the marine water pollution :

- (i) Shipping water pollution
- (ii) Radioactive waste pollution

**(i) Shipping water pollution :** There are 15 million watercrafts on navigable waters and their combined waste discharges are equivalent to a city with a population of 2,000,000. Oil pollution, an oxygen-demanding waste, is of concern not only from sensational major spills from ships and offshore drilling rigs but also from small spill and cleaning operations.

**(ii) Radioactive waste pollution :** The major source of radioactive waste have been nuclear explosion, accidents at nuclear power plants, fuel-reprocessing plants, and research laboratories and hospitals that release these waste into the atmosphere or into wastewater. Presently, most interest centers on radioactive iodine and strontium, since man is at the end of the foods chains that concentrate these elements.

### **Prevention and control of Water pollution**

Biodegradable pollutants alone cause the measure pollution load but there are also several kinds of ingredients such as heavy metals, chemical compounds and mineral oil which can not be decomposed by mechanical or biological means. The various ways techniques suggested for prevention and control of water pollution as briefed as follows:-

**(i) Stabilization of Ecosystem :** It is the most reliable way to control water pollution which involves reduction in waste input, harvesting and removal of biomass, trapping of nutrients, fish management and aeration. Various physical and biological methods are followed to restore species diversification and eco balance in the water body to prevent pollution.

**(ii) Reutilization and recycling of waste :** Various kinds of waste like paper pulp, municipal and industrial effluents, sewage and thermal pollutants can be recycled to advantage. Urban waste could be recycled to generate cheaper fuel gas and electricity. One large urban waste recycling plant is running in New Delhi. The total gas generation from the plant is about 0.6 million cubic feet per day having a heat value of 700-800 BIU per cubic foot.

**(iii) Removal of Pollutants :** The various physiochemical techniques used for removal of chemical, biological or radiobiological pollutants have been absorbed, electro-dialysis, ion exchange and reverse osmosis. Techniques introduced by CSIR for the control of water pollution have been successfully used for the removal and reuse of pollutants from industrial effluents. Some of them are below:-

**(a) Ammonia removal from the waste water of industry :** Ion-exchange technique using a weakly acidic cation exchanger based on methacrylic acid is employed to remove ammonia from waste water in the form of ammonium sulphate which can be reduced for the manufacture of fertilizer. The process has good application potential not only for pollution abatement, but also for the recovery of the pollutant in the form of useful salt.

**(b) Decolourization of water :** An electrolytes decomposition techniques has been developed to decolorize the waste water

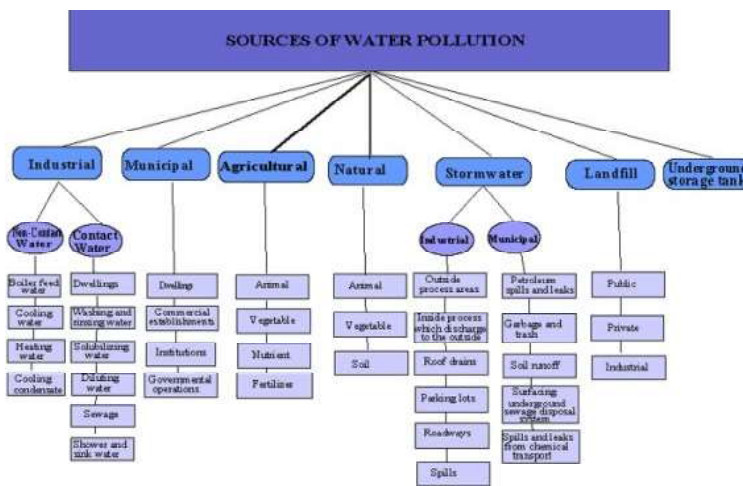


Fig. 8.1. Various sources of water pollution

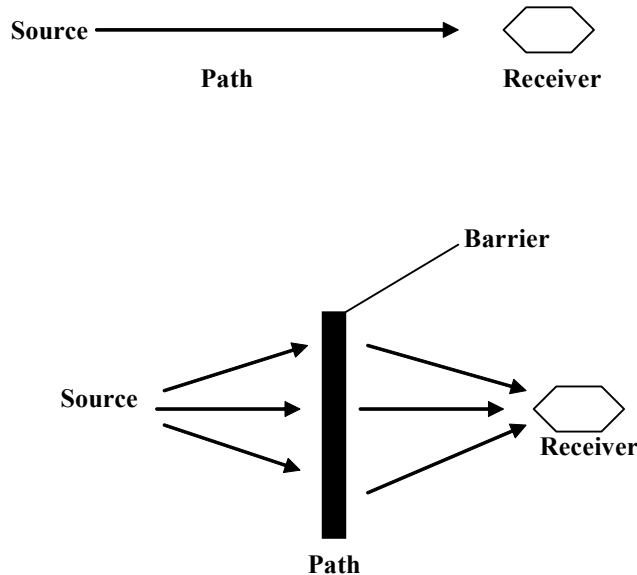
## NOISE POLLUTION

### What is noise?

In simple terms, noise is unwanted sound. Sound is a form of energy which is emitted by a vibrating body and on reaching the ear causes the sensation of hearing through nerves.

Sounds produced by all vibrating bodies are not audible. The frequency limits of audibility are from 20 HZ to 20,000 HZ.

A noise problem generally consists of three inter-related elements- the source, the receiver and the transmission path. This transmission path is usually the atmosphere through which the sound is propagated, but can include the structural materials of any building containing the receiver (Fig. 17).



**Fig. 8.2. Inter-relationship between the elements of noise**

Noise may be continuous or intermittent. Noise may be of high frequency or of low frequency which is undesired for a normal hearing. For example, the typical cry of a child produces sound, which is mostly unfavorable to normal hearing. Since it is unwanted sound, we call it noise.

The discrimination and differentiation between sound and noise also depends upon the habit and interest of the person/species receiving it, the ambient conditions and impact of the sound generated during that particular duration of time. There could be instances that, excellently rendered musical concert for example, may be felt as noise and exceptional music as well during the course of the concert.

Sounds of frequencies less than 20 HZ are called infrasonics and greater than 20,000 HZ are called ultrasonics. Since noise is also a sound, the terms noise and sound are synonymously used.

**Where does noise generate from?** The sources of noise may vary according to daily activities. They sources may be domestic (movement of utensils, cutting and peeling of

fruits/vegetables etc.) natural (shores, birds/animal shouts, wind movement, sea tide movement, water falls etc.), commercial (vendor shouts, automobiles, aeroplanes, marriages, laboratory, machinery etc.) industrial (generator sets, boilers, plant operations, trolley movement, transport vehicles, pumps, motors etc.).

Typical surveys pertaining to causes of noise pollution, reveal the various sources of noise pollution and frequency variation of their occurrences. Road traffic is identified as the major source of noise pollution while at home or outdoors or at work.

**Table 8.1. Typical noise levels of some point sources**

Source	Noise level dB (A)	Source	Noise level dB (A)
Air compressors	95-104	Quiet garden	30
110 KVA diesel generator	95	Ticking clock	30
Lathe machine	87	Computer rooms	55-60
Milling machine	112	Type institute	60
Oxy-acetylene cutting	96	Printing press	80
Pulveriser	92	Sports car	80-95
Riveting	95	Trains	96
Power operated saw	108	Trucks	90-100
Steam turbine (12,500 kW)	91	Car horns	90-105
Pneumatic chiseling	118	Jet takeoff	120

## Impacts of Noise

**Why bother about noise?** Often neglected, noise induces a severe impact on humans and on living organisms. Some of the adverse effects are summarized below:

**Annoyance:** It creates annoyance to the receptors due to sound level fluctuations. The aperiodic sound due to its irregular occurrences causes displeasure to hearing and causes annoyance.

**Physiological effects:** The physiological features like breathing amplitude, blood pressure, heart-beat rate, pulse rate, blood cholesterol are effected.

**Loss of hearing:** Long exposure to high sound levels cause loss of hearing. This is mostly unnoticed, but has an adverse impact on hearing function.

**Human performance:** The working performance of workers/human will be affected as they'll be losing their concentration.

**Nervous system:** It causes pain, ringing in the ears, feeling of tiredness, thereby effecting the functioning of human system.

**Sleeplessness:** It affects the sleeping there by inducing the people to become restless and loose concentration and presence of mind during their activities.

**Damage to material :** The buildings and materials may get damaged by exposure to infrasonic/ultrasonic waves and even get collapsed.

### **How to Control the Noise Pollution**

Noise generation is associated with most of our daily activities. A healthy human ear responds to a very wide range of SPL from - the threshold of hearing at zero dB, uncomfortable at 100-120 dB and painful at 130-140 dB. Due to the various adverse impacts of noise on humans and environment, noise should be controlled. The technique or the combination of techniques to be employed for noise control depend upon the extent of the noise reduction required, nature of the equipment used and the economy aspects of the available techniques.

The various steps involved in the noise management strategy. Reduction in the noise exposure time or isolation of species from the sources form part of the noise control techniques besides providing personal ear protection, engineered control for noise reduction at source and/or diversion in the trajectory of sound waves.

The noise pollution can be controlled at the source of generation itself :

**Reducing the noise levels from domestic sectors :** The domestic noise coming from radio, tape recorders, television sets, mixers, washing machines, cooking operations can be minimized by their selective and judicious operation. By usage of carpets or any absorbing material, the noise generated from felling of items in house can be minimized.

**Maintenance of automobiles :** Regular servicing and tuning of vehicles will reduce the noise levels. Fixing of silencers to automobiles, two wheelers etc., will reduce the noise levels.

**Control over vibrations:** The vibrations of materials may be controlled using proper foundations, rubber padding etc. to reduce the noise levels caused by vibrations.

**Low voice speaking:** Speaking at low voices enough for communication reduces the excess noise levels.

**Prohibition on usage of loud speakers:** By not permitting the usage of loudspeakers in the habitant zones except for important meetings / functions. Now-a-days, the urban Administration of the metro cities in India, is becoming stringent on usage of loudspeakers.

**Selection of machinery:** Optimum selection of machinery tools or equipment reduces excess noise levels. For example selection of chairs, or selection of certain machinery/equipment which generate less noise (Sound) due to its superior technology etc. is also an important factor in noise minimization strategy.

**Maintenance of machines:** Proper lubrication and maintenance of machines, vehicles etc. will reduce noise levels. For example, it is a common experience that, many parts of a vehicle will become loose while on a rugged path of journey. If these loose parts are not properly fitted, they will generate noise and cause annoyance to the driver/passenger. Similarly is the case of machines. Proper handling and regular maintenance is essential not only for noise control but also to improve the life of machine.



### **Control in the transmission path**

In the inter-relationship between elements of noise was represented. The change in the transmission path will increase the length of travel for the wave and get absorbed/refracted/radiated in the surrounding environment. The available techniques are briefly discussed below:

**Installation of barriers:** Installation of barriers between noise source and receiver can attenuate the noise levels. For a barrier to be effective, its lateral width should extend beyond the line-of-sight at least as much as the height.

**Design of building:** The design of the building incorporating the use of suitable noise absorbing material for wall/door/window/ceiling will reduce the noise levels. The approximate reduction of outside noise levels using typical exterior wall construction.

**Installation of panels or enclosures:** A sound source may be enclosed within a paneled structure such as room as a means of reducing the noise levels at the receiver. The actual difference between the sound pressure levels inside and outside an enclosure depends not only on the transmission loss of the enclosure panels but also on the acoustic absorption within the enclosure and the details of the panel penetrations which may include windows or doors.

**Green belt development:** Green belt development can attenuate the sound levels. The degree of attenuation varies with species of greenbelt. The typical attenuation of noise levels by shrubs and trees. The statutory regulations direct the industry to develop greenbelt four times the built-up area for attenuation of various atmospheric pollutants, including noise.

The usage of protective equipment and the worker's exposure to the high noise levels can be minimized by :

**Job rotation:** By rotating the job between the workers working at a particular noise source or isolating a person, the adverse impacts can be reduced.

**Exposure reduction:** Regulations prescribe that, noise level of 90 dB (A) for more than 8 hr continuous exposure is prohibited. Persons who are working under such conditions will be exposed to occupational health hazards. The schedule of the workers should be planned in such a way that, they should not be over exposed to the high noise levels.

**Hearing protection:** Equipment like earmuffs, ear plugs etc. are the commonly used devices for hearing protection. Attenuation provided by ear-muffs vary widely in respect to their size, shape, seal material etc. Literature survey shows that, an average noise attenuation up to 32 dB can be achieved using earmuffs.

**Table 8.2. Indian Standards for ambient noise levels**

Area	Noise limit, Leq, dB (A)	
	Day Time	Night Time
Silence zone	50	45
Residential area	55	45
Commercial area	65	55
Industrial area	75	65

Whether knowingly or unknowingly, everyone of us contribute to noise pollution, because most of our day-to-day activities generate some noise. Often neglected, noise pollution adversely affects the human being leading to irritation, loss of concentration, loss of hearing. Identify the sources of noise pollution. Once identified, the reason(s) for increased noise levels to be assessed. Now, efforts shall be made to reduce the undesired noise levels from (unwanted) noise generating sources. This leads to marginal reduction of noise levels. It is still un-bearable scientific methods of noise control shall be employed. The statutory Regulations have prescribed the noise level exposure limits. The public may complain to the statutory Board for violation of noise level limits by any noise generator. Suitable action will be taken to attenuate the noise levels and controlling pollution. It is advisable that suitable noise control measures be taken and reduce the interference of Statutory Board. It is high time that everyone should do this bit in curbing the noise pollution, which is otherwise becoming as effective as SLOW POISONING.

### **Air Pollution**

Air Pollution, contamination of the atmosphere by gaseous, liquid, or solid wastes or by-products that can endanger human health and the health and welfare of plants and animals, or can attack materials, reduce visibility, or produce undesirable odours. Among air pollutants emitted by natural sources, only the radioactive gas radon is recognized as a widespread major health threat, although gases and particles from volcanic eruptions can cause serious more localized problems.

Each year industrially developed countries generate billions of tons of pollutants. The most prevalent and widely dispersed air pollutants are described in the accompanying table. The level is usually given in terms of atmospheric concentrations (micrograms of pollutants per cubic metre of air) or, for gases, in terms of parts per million, that is, millilitres of gas per thousand litres of air. Many come from directly identifiable sources; sulphur dioxide, for example, comes from electric power plants burning coal or oil. Others are formed through the action of sunlight on previously emitted reactive materials (called precursors). For example, ozone, a dangerous pollutant in smog, is produced by the interaction of hydrocarbons and nitrogen oxides under the influence of sunlight. Ozone also causes serious crop damage.

### **Meteorology and Health Effects**

Pollutant concentration is reduced by atmospheric mixing, which depends on such weather conditions as temperature, wind speed, and the movement of high and low pressure systems and their interaction with the local topography, for example, mountains and valleys. Normally, temperature decreases with altitude. But when a colder layer of air settles under a warm layer, producing a temperature or thermal inversion, atmospheric mixing is retarded and pollutants may accumulate near the ground. Inversions can become sustained under a stationary high-pressure system coupled with low wind speeds.

Periods of only three days of poor atmospheric mixing can lead to high concentrations of hazardous materials in high-pollution areas and, under severe conditions, can result in injury and even death. An inversion over Donora, Pennsylvania, in 1948 caused respiratory illness in over 6,000 people and led to the deaths of 20. Severe pollution in London took 3,500 to 4,000 lives in 1952 and another 700 in 1962. Release of methyl isocyanate into the air during a temperature inversion caused the disaster at Bhopal, India, in December 1984, with at least 3,300 deaths and more than 20,000 illnesses. The effects of long-term exposure to low concentrations are not well defined; however, those most at risk are the very young, the elderly, smokers, workers whose jobs expose them to toxic materials, and people with heart or lung disease. Other adverse effects of air pollution are injury to livestock and crops.

### **Sources of air Pollution**

The combustion of coal, oil, and petrol accounts for much of the airborne pollutants. About 60 per cent of the sulphur dioxide and 20 per cent of the nitrogen oxides emitted into the atmosphere in the United Kingdom are produced by fossil-fuel-fired electric power plants. About 70 per cent of the carbon monoxide and 50 per cent of the nitrogen oxides come from burning petrol and diesel in cars and lorries. Other major pollution sources include iron and steel mills; smelters; municipal incinerators; oil refineries; cement plants; and nitric and sulphuric acid plants.

Potential pollutants may exist in the materials entering a chemical or combustion process (such as sulphur in coal), or they may be produced as a result of the process itself. Carbon monoxide, for example, is a typical product of internal-combustion engines. Methods for controlling air pollution include removing the hazardous material before it is used, removing the pollutant after it is formed, or altering the process so that the pollutant is not formed or occurs only at very low levels. Car exhaust pollutants can be controlled by burning the fuel as completely as possible, by re-circulating fumes from fuel tank, carburettor, and crankcase, and by changing the engine exhaust to harmless substances in catalytic converters. Industrially emitted particulates may be trapped in cyclones, electrostatic precipitators, and filters. Pollutant gases can be collected in liquids or on solids, or incinerated into harmless substances.

### **Large-scale Effects**

The tall smokestacks used by industries and utilities do not remove pollutants but simply boost them higher into the atmosphere, thereby reducing their concentration at the site. These pollutants may then be transported over large distances and produce adverse effects in areas far from the site of the original emission. Sulphur dioxide and nitrogen oxide emissions from Britain and other industrialized countries of Western and Central Europe have caused acid rain in Norway and Sweden. The pH level, or relative acidity, of many freshwater lakes has been altered so dramatically by acid rain that entire fish populations have been destroyed. Sulphur dioxide emissions and the subsequent formation of sulphuric acid can also be responsible for the attack on limestone and marble at large distances from the source. There are also claims that acid rain has caused widespread damage to forests in Europe, but the precise role is unclear and earlier predictions of large-scale forest death are unfounded.

The worldwide increase in the burning of coal and oil since the late 1940s has led to ever-increasing concentrations of carbon dioxide. The resulting “greenhouse effect”, which allows solar energy to enter the atmosphere but reduces the reemission of infrared radiation from the Earth, may well lead to a warming trend that might affect the global climate and lead to a partial melting of the polar ice-caps. Possibly an increase in cloud cover or absorption of excess carbon dioxide by the oceans (in the so-called carbon cycle) would check the greenhouse effect before it reached the stage of polar melting. Nevertheless, many research reports released during the 1990s have indicated that the greenhouse effect is definitely under way and that the nations of the world should be taking immediate steps to deal with it. In June 1999 a massive cloud of air pollution, roughly the size of the United States, was discovered 1 km to 3 km above the Indian Ocean. The thick brown haze included soot, sulphates, nitrates, mineral dust, and significant amounts of gases such as carbon monoxide and sulphur dioxide. Scientists believe it was created by human activities, especially the burning of fossil fuels, and could have a significant impact on the regional and global climate, as well as plant and animal life.

### **Control Actions by Government**

Various countries have set standards in legislation in the form of concentration levels that are believed to be low enough to protect public health. Source emission standards are also specified to limit the discharge of pollutants into the air so that air-quality standards will be achieved. However, the nature of the problem requires the implementation of international environmental treaties, and to this end 49 countries agreed in March 1985 on a United Nations convention to protect the ozone layer. This “Montreal Protocol”, which was renegotiated in 1990 and 1992, called for the phaseout of certain chlorocarbons and fluorocarbons by the end of the century and provides aid to developing countries in making this transition. In addition, several international protocols have been aimed specifically at reducing the incidence of acid rain. In December 1999

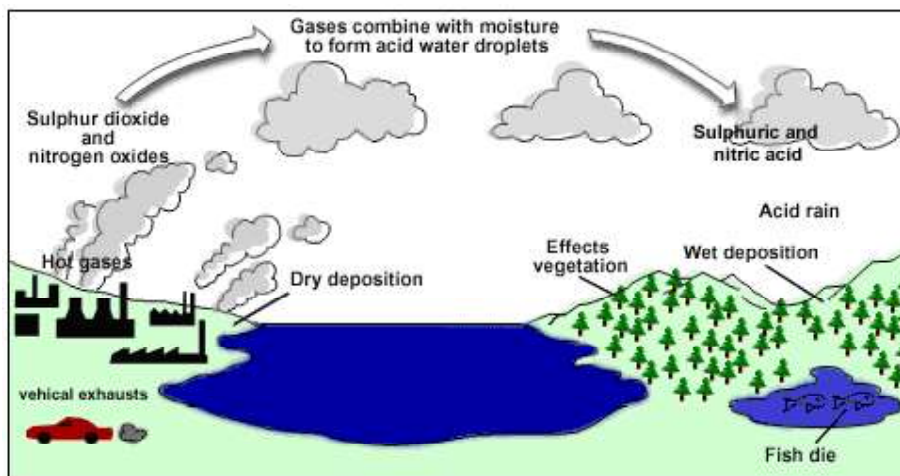
the Montreal Protocol announced that almost all production and consumption of virgin ozone depleting substances had been phased out in the developed world. Similar control measures were introduced for developing countries in July 1999, and it was anticipated that all developing countries would be able to meet their freeze targets and subsequent obligations under the protocol.

Concern over trans-boundary air pollution, including acid rain, in Europe has led to the United Nations Economic Commission for Europe (UNECE) developing air quality guidelines, called Critical Loads and Levels, which represent thresholds below which it is believed that damage will not occur to different ecological systems. Critical Loads are based on the amount of acidity that an ecosystem can tolerate being deposited indefinitely. Critical Levels are concentrations of ozone, sulphur dioxide, and nitrogen oxides over different averaging times and applicable to different categories of vegetation. Massive cuts are being made in emissions in Europe in order to move towards these thresholds. In contrast, in many developing countries, pollutant concentrations are rising very rapidly due to increased industrialization and motor traffic; concern in such places is primarily with impacts on human health in cities.

### **Acid Rain**

Acid Rain, form of air pollution, currently a subject of great controversy because of the widespread environmental damage for which it has been blamed. It forms when oxides of sulphur and nitrogen combine with atmospheric moisture to yield sulphuric and nitric acids, which may then be carried long distances from their source before they are deposited by rain. The pollution may also take the form of snow or fog or be precipitated in dry forms. In fact, although the term “acid rain” has been in use for more than a century—it is derived from atmospheric studies that were made in the region of Manchester, England—the more accurate scientific term would be “acid deposition”. The dry form of such precipitation is just as damaging to the environment as the liquid form.

The problem of acid rain originated with the Industrial Revolution, and it has been growing ever since. The severity of its effects has long been recognized in local settings, as exemplified by the periods of acid smog in heavily industrialized areas. The widespread destructiveness of acid rain, however, has become evident only in recent decades. One large area that has been studied extensively is northern Europe, where acid rain has eroded structures, injured crops and forests, and threatened or depleted life in freshwater lakes. In 1984, for example, environmental reports indicated that almost half of the trees in Germany's Black Forest had been damaged by acid rain. The north-eastern United States and eastern Canada have also been particularly affected by this form of pollution; damage has also been detected in other areas of these countries and other regions of the world. In China, rapid industrial growth and an increasing demand for coal in the 1990s has led to a dramatic rise in environmental damage from acid rain. Nearly 40 per cent of China's land area is now affected, and scientists expect that it will continue to rise.



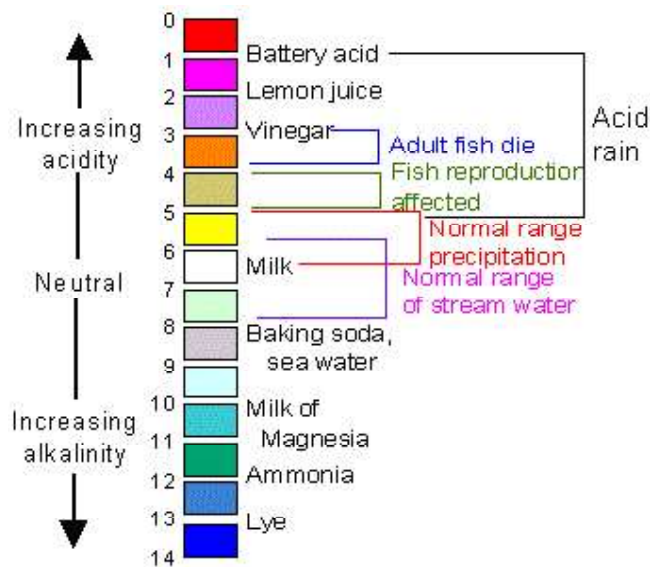
**Fig. 8.3. Acid rain formation**

### **Cause of Acid Rain**

Industrial emissions have been blamed as the major cause of acid rain. Because the chemical reactions involved in the production of acid rain in the atmosphere are complex and as yet little understood, industries have tended to challenge such assessments and to stress the need for further studies; and because of the cost of pollution reduction, governments have tended to support this attitude. Studies released by the US government in the early 1980s, however, strongly implicated industries as the main source of acid rain, in the eastern United States and Canada. In 1988, as part of the United Nations Convention on Long-Range Transboundary Air Pollution Agreement (1979), 25 nations ratified a protocol freezing the rate of nitrogen oxides emissions at 1987 levels. The 1990 amendments to the US Clean Air Act of 1967 put in place regulations to reduce the release of sulphur dioxide from power plants by half to about 10 million tonnes per year by January 2000. A further reduction to 8.95 million tonnes was introduced in 2000 to be achieved by 2007, although it is not expected to be realized until 2010.

In Europe, the 1979 Convention is administered through the United Nations Economic Commission for Europe. The UNECE produced the first Sulphur Protocol (1985), which called for a reduction of sulphur emissions to 70 per cent of 1980 levels by 1993 (this was the only UNECE protocol not signed by the United Kingdom, although it nevertheless achieved the reduction, as did the 21 countries that did sign); the Nitrogen Oxides protocol (1988), which stipulated that total annual emissions of nitrogen oxides should not exceed 1987 levels by December 1994 (achieved by 17 of the 26 countries that signed the protocol as of 1996, including several significant reductions); the Volatile Organic Compounds Protocol (1991), which called for a reduction in emissions to 70 per cent of 1988 levels by 1999 (7 of the 17 countries that signed the protocol achieved their targets, including the UK, while most achieved considerable progress as of 2000); and the second Sulphur

Protocol (1994), by which sulphur emissions are to be reduced in intermediate stages to a goal of 20 per cent of 1980 levels by 2010 (by 2000, 15 of the 20 countries that signed the protocol had attained the emission reductions required for that intermediate stage, while another 4 were on course to do so). In addition, catalytic converters, which reduce the emission of nitrogen oxides, have been compulsory on all new cars in the UK since 1993.



**Fig. 8.3. pH levels of different sources**

In October 1999 scientists from the Environmental Protection Agency in the United States claimed that lakes and streams across Europe and North America appeared to be recovering from the damage done by acid rain and that this recovery was mainly due to the stricter controls on industrial emissions of sulphur dioxide. The researchers warned, however, that it would still take decades before the widespread damage to forests, crops, and human health could be completely reversed.

### Land Pollution

Pollution is a global problem. It has affected the lives of millions of people and caused several deaths and health problems. Land pollution is one of the types of pollution. **“Land pollution is pollution of our planet’s land surface”.**

### Causes of Land Pollution

- Increase in urbanization is one of the major causes of land pollution. Construction uses up forestland. This leads to the exploitation and destruction of forests. There is more demand for water. Reservoirs are built resulting in the loss of land.

- The disposal of non-biodegradable wastes, including containers, bottles and cans made of plastic, used cars and electronic goods, leads to the pollution of land.
- Agricultural wastes including the waste matters produced by crop, animal manure and residues of the farm land are one of the major causes of land pollution. The pesticides and fertilizers used by farmers to increase the crop yield, leaches into the nearby land areas and pollutes them.
- The process of mining leads to the formation of piles of coal and slag. When these wastes are not disposed through proper channel, they are accumulated and contaminate the land.
- Industrial wastes are major contributors of land pollution. Dumping of toxic materials such as chemicals and paints makes the areas surrounding the industries, look very filthy.
- Improper treatment of sewage leads to the accumulation of solids, such as biomass sludge. These solid wastes overflow through the sewage, making the entire area look dirty.
- Burning of solid fuels leads to the formation of ashes, which is yet another cause of land pollution.
- Although domestic and industrial wastes are collected and recycled or burnt in incinerators, a large amount of rubbish is left untreated. These are then dumped into grounds, leading to land pollution.
- Garbage dumped by people makes the streets unhealthy, unfit and dirty to reside in. The waste matter usually consists of leftover food, fruit and vegetable peels and other non decomposable solid materials such as glass, cloth, plastic, wood, paper etc.

### **Harmful Effects of Land Pollution**

- Tonnes and tonnes of domestic wastes are dumped every day. Since people do not follow proper methods for the disposal of such wastes, it leaves the places look dirty and makes them unhealthy.
- Land pollution indirectly affects the respiratory system of human beings. Breathing in polluted dust or particle can result in a number of health problems related to the respiratory system.
- Skin problems are often diagnosed due to land pollution. It is said that the improper disposal of household wastes leads to allergic reactions on the skin.
- Land pollution has been found as one of the leading causes for birth defects. Pregnant women living in unhealthy and dirty environment can incur breathing problems and a number of diseases, which may affect the health of the baby as well.



- Land pollution has serious effect on wildlife. Flora, which provides food and shelter to wildlife, are destroyed.
- Land pollution often disrupts the balance of Nature, causing human fatalities.

### **How to Prevent Land Pollution**

Land pollution refers to the degradation of the land due to human activities, such as the exploitation of minerals, poor disposal of waste and improper utilization of soil. Deforestation, urbanization and industrialization are the factors responsible for land pollution. These processes have destroyed habitats and polluted the environment— affecting animals and humans. One of the chief reasons for the land pollution is disposal of solid waste obtained from human and animal activities. Non-biodegradable material that cannot be broken down or decomposed is dumped onto the environment.

- Reduce toxic materials. Waste materials that are disposed of should have minimal toxic materials. This can be done by treating the waste materials with various chemicals to make them less toxic. Once the waste is treated, it can be disposed of using responsible methods. Harmful chemicals can also be replaced with less toxic, biodegradable materials.
- Recycle waste materials. As explained by the Stanford Recycling Center, each American throws away 7 1/2 lbs. of garbage. Garbage requires land fills, which takes up large amounts of land.
- Buy organics products, especially organic cleaners, pesticides, insecticides and fertilizers. The advantage of using organic products is that they are biodegradable and friendly to the environment.
- Avoid littering. Excessive littering is one of most common reasons for land pollution.
- Take initiative to inform others about the harmful effects of littering. Organic wastes must be disposed off in areas that are far from human or animal habitation. Waste like plastic, metals, glass and paper must be recycled and reused.
- Improve fertility of the land by reforestation. Soil in forested lands are far more fertile than soil without trees, suggesting that trees have the ability to fertilize land.
- Find land far away from natural environments to dump wastes that cannot be disposed of and are essential to industrial processes.

### **Automobiles Pollution**

No invention has had as profound effect on society as the passenger automobile. It did not take long after its introduction in the early part of this century for the auto to quickly become the primary means of transportation in the world. But reliance on cars is not without its problems; the most obvious being air pollution and energy consumption.

## Cars and Pollution

Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity.

Impacts of automobile pollution caused by cars :

- lung cancer,
- respiratory problems,
- urban smog
- acid rain

By 1970, after decades without government regulation, air quality had become a serious problem. However, the Clean Air Act didn't prohibit pollution; it simply defined an "acceptable" amount. Further, the legislation addressed only certain airborne contaminants, while ignoring others. Perhaps most significantly, although bad air was outlawed, it still exists. More than half of the people in the world live in areas that failed to meet air quality standards. Despite the Clean Air Acts, the reality is that air pollution continues to be a major public health problem.

As almost all the countries have waited too long to address the pollution caused by cars, it's worse. Mexico City, São Paulo, New Delhi, and Bangkok are grappling with serious air problems. And much of that pollution is caused by private automobiles.

How cars cause pollution

The power to move a car comes from burning fuel in an engine. Pollution from cars comes from by-products of this combustion process (exhaust) and from evaporation of the fuel itself.

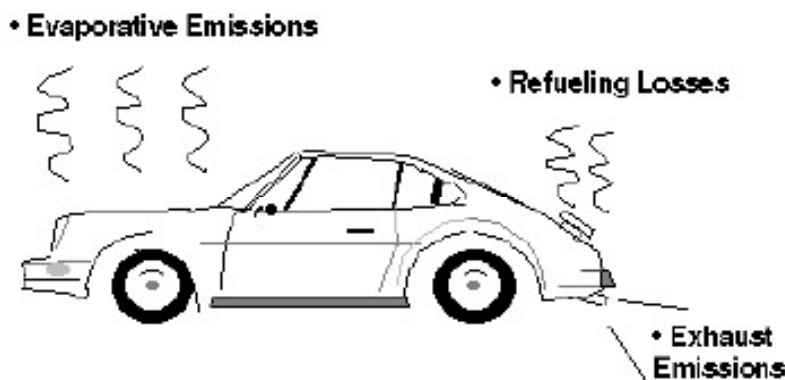


Fig. 8.3. Pollution caused by cars

Petroleum and diesel fuels are mixtures of hydrocarbons, compounds which contain hydrogen and carbon atoms. In a “perfect” engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be “perfect,” and automotive engines emit several types of pollutants.

### **Perfect Combustion**

FUEL (hydrocarbons) + AIR ( $O_2$  &  $N_2$ )  $CO_2$  +  $H_2O$  + unaffected nitrogen

### **Typical Engine Combustion**

FUEL + AIR UNBURNED HYDROCARBONS + NO + CO +  $CO_2$  +  $H_2O$

### **Exhaust Pollutants**

**1. Hydrocarbons :** Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. It is our most widespread and intractable urban air pollution problem. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer.

**2. Nitrogen Oxides (No) :** Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various nitrogen oxides, collectively known as NO. Nitrogen oxides, like hydrocarbons, are precursors to the formation of ozone. They also contribute to the formation of acid rain.

**3. Carbon Monoxide :** Carbon monoxide (CO) is a product of incomplete combustion and occurs when carbon in the fuel is partially oxidized rather than fully oxidized to carbon dioxide ( $CO_2$ ). Carbon monoxide reduces the flow of oxygen in the bloodstream and is particularly dangerous to persons with heart disease.

**4. Carbon Dioxide :** In recent years, the Environmental Protection Agency (EPA) has started to view carbon dioxide, a product of “perfect” combustion, as a pollution concern. Carbon dioxide does not directly impair human health, but it is a “greenhouse gas” that traps the earth’s heat and contributes to the potential for global warming

### **Evaporative Emissions**

Hydrocarbon pollutants also escape into the air through fuel evaporation. With today’s efficient exhaust emission controls and today’s petroleum formulations, evaporative losses can account for a majority of the total hydrocarbon pollution from current model cars on hot days when ozone levels are highest.

Evaporative emissions occur several ways :

**Diurnal :** Petroleum evaporation increases as the temperature rises during the day, heating the fuel tank and venting petroleum vapors.

**Running Losses :** The hot engine and exhaust system can vaporize petroleum when the car is running.

**Hot Soak :** The engine remains hot for a period of time after the car is turned off, and petroleum evaporation continues when the car is parked.

**Refueling :** Petroleum vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with liquid fuel.

### **Lead Pollution caused by Cars**

Cars also pollute by emitting lead from leaded gasoline. Although the use of lead in petroleum is banned in few countries, leaded petroleum is common in other countries. In fact, of the countries for which data is available, 43% use nothing but leaded gasoline. Many of the rest use at least some leaded petroleum in their energy mix.

Lead is one of the oldest metals used by humans, lead is a cumulative neurotoxin that impairs brain development among children and has been connected to elevated blood pressure and resulting hypertension, heart attacks, and premature death in adults. Emissions from vehicles are the largest source of lead exposure in many urban areas.

The effects of all this pollution on human health are unsettling. The mortality rates were 17-26% higher in cities with the dirtiest air compared to those with the cleanest air. Not surprisingly, the study also found correlations between bad air and lung cancer and cardiopulmonary disease. The risks translate roughly to a two-year shorter life span for residents of dirty-air cities. On a global basis, estimates of mortality due to outdoor air pollution range from about 0.4-1.1% of total annual deaths.

### **Global Warming caused by automobiles**

Perhaps even scarier than the direct damage to our bodies from auto pollution is the fact that car emissions are contributing to an overall warming of the entire planet, which could destroy the world's food chain.

Cars emit carbon dioxide (CO<sub>2</sub>), a heat-trapping gas. Atmospheric concentrations of CO<sub>2</sub> have increased by 30% since pre-industrial times, and much of that increase is directly related to the burning of fossil fuels. According to the authorities "CO<sub>2</sub> levels are now at their highest point in 160,000 years, and global temperatures at their highest since the Middle Ages".

The effects of this global warming are frightening :

- Rising sea levels,
- Dying coral reefs,
- Spreading of infectious diseases,
- Extreme weather conditions, including droughts, rare forest fires, historic floods, and severe storms.

Automobiles are responsible for a tremendous amount of air pollution and wasted energy. These problems impact people all over the world, both motorists and non-motorists alike, by affecting their health, their economies, and their communities. Legislation to address air pollution has been only partially successful, and air quality continues to be a major concern in countries all over the world. As for energy use, one can only hope that world leaders find a better way to address this problem than fighting wars over an increasingly shrinking supply of oil.

### Ozone Layer Depletion

Today, one of the most discussed and serious environmental issue is the ozone layer depletion, the layer of gas that forms a protective covering in the Earth's upper atmosphere. Ozone is formed when oxygen molecules absorb ultraviolet photons and undergo a chemical reaction known as photo dissociation or photolysis, where a single molecule of oxygen breaks down to two oxygen atoms. The free oxygen atom (O), then combines with an oxygen molecule ( $O_2$ ) and forms a molecule of ozone ( $O_3$ ). The ozone molecule, in turn absorb ultraviolet rays between 310 to 200 nm wavelength and thereby prevent these harmful radiations from entering the Earth's atmosphere. In the process, ozone molecules split up into a molecule of oxygen and an oxygen atom. The oxygen atom (O) again combines with the oxygen molecule ( $O_2$ ) to regenerate an ozone ( $O_3$ ) molecule. Thus, the total amount of ozone is maintained by this continuous process of destruction and regeneration.

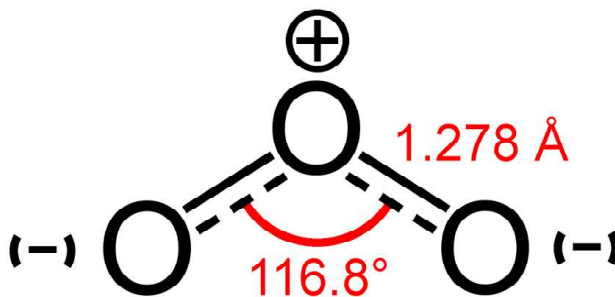


Fig. 8.4. Ozone Molecule

The distribution of ozone ( $O_3$ ) in the stratosphere is a function of altitude, latitude and season. It is determined by photochemical and transport processes. The ozone layer is located between 10 and 50 km above the Earth's surface and contains 90% of all stratospheric ozone. Under normal conditions, stratospheric ozone is formed by a photochemical reaction between oxygen molecules, oxygen atoms and solar radiation.

### Importance of Ozone Layer

The ozone layer is essential to life on earth, as it absorbs harmful ultraviolet-B radiation from the sun. In recent years the thickness of this layer has been decreasing, leading in extreme cases to holes in the layer. Measurements carried out in the Antarctic have shown that at certain times, more than 95% of the ozone concentrations found at altitudes of between 15 and 20 km and more than 50% of total ozone are destroyed, with reductions being most pronounced during winter and in early spring. Natural phenomena, such as sun-spots and stratospheric winds, also decrease stratospheric ozone levels, but typically not by more than 1-2%.

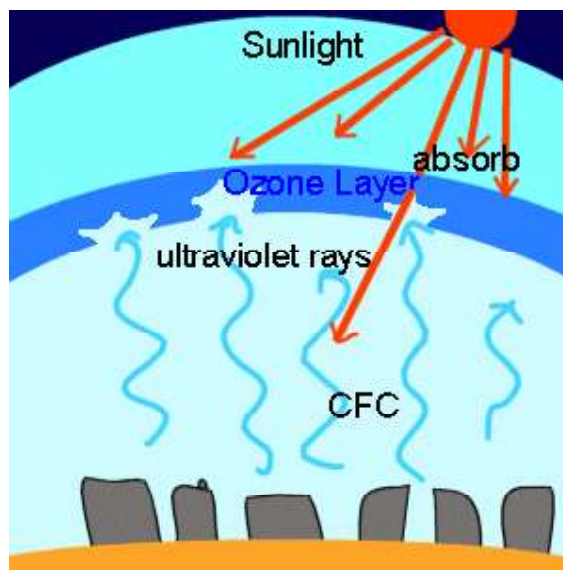


Fig. 8.5. Ozone layer depletion

### The cause of Depletion of Ozone Layer

Ozone layer depletion first captured the attention of the whole world in the later half of 1970 and since then, many discussions and researches have been carried out to find out the possible effects and the causes of ozone depletion. Many studies have also been directed to find out a possible solution.

The cause of ozone depletion is the increase in the level of free radicals such as hydroxyl radicals, nitric oxide radicals and atomic chlorine and bromine. The most important compound, which accounts for almost 80% of the total depletion of ozone in the stratosphere are chlorofluorocarbons (CFC). These compounds are very stable in the lower atmosphere of the Earth, but in the stratosphere, they break down to release a free chlorine atom due to ultraviolet radiation. A free chlorine atom reacts with an ozone molecule ( $O_3$ ) and forms chlorine monoxide (ClO) and a molecule of oxygen. Now chlorine

monoxide reacts with an ozone molecule to form a chlorine atom and two molecules of oxygen. The free chlorine molecule again reacts with ozone to form chlorine monoxide. The process continues and the result is the reduction or depletion of ozone in the stratosphere. Aircraft emissions of nitrogen oxides and water vapor add to this depletion effect by creating ice crystals that serve as a base for ozone destroying reactions.

The main potential consequences of this ozone depletion summarized below :

- **Increase in UV-B radiation at ground level :** a one percent loss of ozone leads to a two percent increase in UV radiation. Continuous exposure to UV radiation affects humans, animals and plants, and can lead to skin problems (ageing, cancer), depression of the immune system, and corneal cataracts (an eye disease that often leads to blindness). Increased UV radiation may also lead to a massive die-off of photoplankton (a CO<sub>2</sub> “sink”) and therefore to increased global warming.
- Disturbance of the thermal structure of the atmosphere, probably resulting in changes in atmospheric circulation;
- **Reduction of the ozone greenhouse effect:** ozone is considered to be a greenhouse gas. A depleted ozone layer may partially dampen the greenhouse effect. Therefore efforts to tackle ozone depletion may result in increased global warming.
- Changes in the tropospheric ozone and in the oxidising capacity of the troposphere.

## Conclusion

Today pollution is undoubtedly the most important limiting factors for humans. It is difficult to put a price tag on the cost of pollution, but it is clear that pollution places a burden on human society from:-

1. the loss of resources owing to unnecessarily wasteful exploitation,
2. the cost of abating and controlling pollution and
3. the cost of human health.

## SHORT ANSWER

1. Explain the water pollution and its impacts.
2. How land pollution is harmful for the ecosystem? Explain.
3. What do you understand by Acid rain?
4. How cars cause pollution. Discuss the impacts of it?
5. Discuss in brief about the impacts of noise pollution.
6. Discuss the pollution in the oceans and its impacts.
7. What are the various sources of noise pollution?
8. What do you know about the Land Degradation?
9. Discuss various diseases caused by automobile pollution.
10. Differentiate between perfect combustion and typical engine combustion.

**LONG ANSWER**

1. Discuss the various pollutions and their impacts.
2. What do you know about noise pollution?
3. Air pollution is the one of the major problem of today. Discuss.
4. How the pollution is causing the global warming?
5. How we can reduce the impact of automobile pollution?
6. How ammonia can be removed from waste water?
7. Discuss the impacts of noise pollution on children and old people.
8. Discuss the various sources and control of air pollution.
9. Discuss the pollution caused by Lead.
10. How the ozone layer is depleting?

**TRUE/FALSE**

1. Cars and trucks exhaust the hydrocarbons.
2. Global warming is causing the increase in precipitation.
3. According to Indian standards ambient noise level in silence zone is 50 dB.
4. UNECE has developed the guidelines for air quality.
5. Sulphur protocol was introduced in 1985.
6. The pH of acid rain ranges 14-15.
7. Burning of fuel and air in engine produce  $H_2O_2$ .
8. Coral reefs dies because of Noise pollution.
9. Ozone layer is situated between 75-110 km above the surface.
10. Air pollution cause 0.4-1.1% of annual mortality.

**FILL IN THE BLANKS**

1. Increasing urbanization is causing \_\_\_\_\_ pollution.
2. Air compressor produce the sound up to \_\_\_\_\_ dB.
3. Acid rain forms when oxides of \_\_\_\_\_ and \_\_\_\_\_ combines with moisture.
4. Automobile pollution cause \_\_\_\_\_ cancer.
5. \_\_\_\_\_ is one of the oldest metal used by human.
6. Frequency limit of audibility are \_\_\_\_\_ Hz to \_\_\_\_\_ Hz.
7. Sports cars produce \_\_\_\_\_ dB sound level.
8. Montreal protocol was announced in \_\_\_\_\_.
9. Acid rain is also known as \_\_\_\_\_.
10. The pH of milk is \_\_\_\_\_.



## CHAPTER

# 9

## Animal Husbandry

The branch of science, which deals with the study of various breeds of domesticated animals and their management for obtaining better products and services from them is termed animal husbandry (the term husbandry comes from 'husband' which means one who takes care).

- **Milk giving (milch) animals:** Cows, buffaloes and goats who give us milk.
- **Meat and egg giving animals:** Pigs, cattle, goat, sheep, fowls and ducks which are the main source of meat. From hens and ducks we get eggs.
- **Working (draught) animals:** Bullocks, buffaloes, camels and horses are draught animals used for doing work in the field and for transportation of goods and human beings.

Mules are also used especially by the army to take things from one place to another in the hilly areas. We also get horns, feathers and leather from some of these animals which can be used for making various things. Their urine and droppings help to make the soil fertile by acting as manure.

### Need for Animal Husbandry

We have a large number of animals in our country. Yet we do not get as much food from these animals as we possibly can and need for our large population. Besides the food, which we get from animals, we need them to do a lot of our work. In India, we have about 80.4 million cattle, which work in the fields. If we take the ratio of working cattle to the area of land, which is being used for cultivation we find that only two individuals of cattle are available to plough 3.8 hectares of land.

We all know that cattle wastes like urine and faeces are natural manure which enrich our soil. Unfortunately, in India we do not use all the cowdung available and a lot of it goes waste. Gobar gas plants have been developed so that we can make use of the cattle dung both for fuel as well as to make manure.

Thus, we find that animal husbandry is a very important field which helps us to improve our livestock and other useful animals and make the maximum use of them.

### **Management of Livestock**

When we study about improving our livestock we learn how they must be sheltered, fed, and mated, what kind of drinking water should be given to them and how the sick and diseased animals ought to be treated? This way we learn to manage our livestock for better production and utilization.

**1. Feeding of animals :** All animals must be fed properly. The food should contain the requisite nutrients i.e. carbohydrates, proteins, fats, minerals, vitamins and water.

The food which is given to cattle can be divided into two categories :

- (i) **Concentrates** like cotton seeds, oilcakes, cereal grains, bran etc. They are very rich in most of the nutrients.
- (ii) **Roughage** includes fibrous and rough food like straw and stems of cereal crops. Generally roughage has a low nutrient content.

An average Indian cow eats about 15-20 kg of green fodder and 4 to 5 kg dry-grass, which is mixed with a sufficient amount of grain. A cow drinks about 32 litres of water. Goat and sheep eat grass, herbs and waste products from the farms. Pigs are usually given cereals and their products to eat. Poultry birds are given a mixed feed consisting of cereals, bone meal, minerals and vitamins.

**2. Housing of animals :** We must protect our animals from too much heat, rain and cold. We must, therefore, be careful where we house them. Their houses should have proper sanitation and ventilation. Too many animals should never be kept in a small space. Different animals require different types of houses. Hens and fowls are kept in cages while sheep and goats stay in open yard, which is partially covered with roof made of straw. This open yard should have a hedge of iron wires all around to prevent the animals from running away.

**3. Water and its supply :** To keep these animals healthy they should be given clean water to drink and in sufficient quantities. For example, on an average a cow consumes about 27-36 Ltr of water, pigs require 5-23 Ltr, camel 8-90 Ltr and poultry birds require about 240 ml of water. Besides this we must also bathe the cattle with clean water.

**4. Some common diseases of animals and vaccination :** Sometimes domestic animals may be afflicted by diseases. Some of the common diseases of animals are listed below:

**(a) Viral diseases :** Pox in cattle, goats, sheeps, and fowls; dermatitis in goats and sheep; foot and mouth disease in cattle.

**(b) Bacterial diseases :** Tuberculosis in cattle and poultry birds; cholera in fowls; diphtheria in calf; diarrhea in chicks; foot rot in sheep.

Most of these diseases can be prevented by proper sanitation, a controlled diet, proper housing and also by vaccinating the animals against these diseases at the proper time and age.

**5. Animal breeding :** Breeding means to reproduce. In case of animals, breeding is done to obtain animals with desired characters. The two individuals of desirable characters can be selected as parents. These are then crossed to obtain new breeds of animals, e.g. by cross breeding a cow of low milk yielding breed, we can get breeds of cow which produces more milk.

**Artificial insemination** is an important and effective method of breeding. The process involves injecting the semen obtained from desired bull belonging to high milk yielding breed into the reproductive tract of female during heat period. It generally gives important breeds, and is widely used to improve the qualities of cow, buffaloes, poultry, horse and goat etc.

### **Important Breeds of Cow**

In India, improved breeds of dairy cows have been developed at National Dairy Research Institute (NDRI), Karnal, Haryana. Some examples are:

- Karan Swiss (Crossbreed of brown Swiss and Sahiwal)
- Karan Fries (Crossbreed of Tharparkar and Holstein-Friesian)
- Frieswal (Crossbreed of Holstein-Friesian and Sahiwal)

Over the last two decades, improved practices of raising animals have resulted in the development of new breeds of dairy animals, poultry and pigs.

### **Conclusion**

Animal husbandry, means the breeding, feeding, and management of animals for the production of food, fibre, work, and pleasure. Modern methods concentrate on one type of animal in large, efficient farming units that generate animal products at the highest rate of return for investment. Intensive husbandry conditions include large numbers of animals in small pens or cages, enriched feed, growth stimulation by various means, and vaccination against disease. Most of the world's domestic animals, however, are raised in small units under less efficient conditions and at lower rates of return. Therefore, if the authorities would provide the help to these small units, it can become a large scale industry.

### **LONG ANSWER**

1. Explain the Animal husbandry.
2. Discuss the need of animal husbandry for the human.
3. What are the major diseases damaging the animals?
4. Name some of the major breeds of cows are being used by human.
5. Discuss in detail the contribution of NDRI, Karnal in the field of Animal Husbandry.

**SHORT ANSWER**

1. What are the positive aspects of Animal husbandry?
2. How we can manage our livestock effectively?
3. Discuss the importance of balanced feeding of cattlev.
4. How the animal breeding can be improved by scientific advice?
5. Is artificial insemination is right or not?

**TRUE/FALSE**

1. NDRI is situated in Jammu & Kashmir.
2. Karan fries is crossbreed of Tharparkar & Holstein-friesian.
3. Viral diseases can affect the cattle.
4. Poultry birds needs 75 ml of water/day.
5. Indian cow needs \_\_\_\_\_ kg of fodder.

**FILL IN THE BLANKS**

1. Crossbreed of brownswiss and sahiwal is \_\_\_\_\_.
2. Tuberculosis also found in \_\_\_\_\_ except human.
3. An average cow consume \_\_\_\_\_ liter of water/day.
4. \_\_\_\_\_ & \_\_\_\_\_ are good nutrient sources of food for cattle.
5. India has about \_\_\_\_\_ million cattle.

## CHAPTER

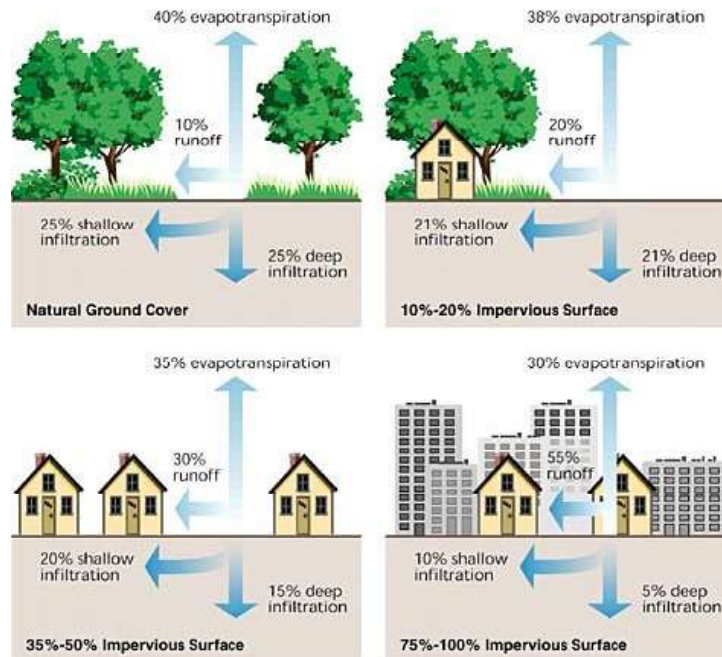
# 10

## Urbanization and Solid Waste Management

Urbanization has two general definitions in the geographical and environmental literature:

- It often refers to the environment and concentration of the humans from rural areas and their villages to towns and cities.
- It can also be defined as the transformation an area on the surface of the earth to an urban pattern of land use.

People living in rural areas depend on agriculture or other means natural resource harvesting for their survival. Rural populations can sometimes organize themselves into villages. A village is a small number of rural households linked together because of culture, customs, family ties, and as association with farming land or harvesting resources. In urban areas, the majority of the people living here do not directly depend on farming or natural resource harvesting for their livelihood. Urbanites can often have jobs in education, commerce, industry, science and the arts. Towns are defined as human settlements that are larger than a village but smaller than a city. Towns generally have centralized areas within them where commerce and business are the activities of the residing citizens. A city is a complex human settlement with built areas that specialize in particular types of industry, commerce and residential living. Cities with populations greater than 10 million are called as mega-cities.



**Fig. 10.1. Impact of Urbanization**

Ever since the beginning of the Industrial Revolution, the rate of urbanization has been increasing more rapidly. Industrialization, the mass production of goods, and the development of commercialized commerce had a great effect on the movement of people from rural areas to urban areas. In 1900 about 15% of the human population lived in towns and cities. By 1990, about 45% of the Earth's human population were concentrated in urban areas. Demographers estimate that in the year 2025 about 60% of the world's population will be living in urban communities.

Urbanization in MDCs is now beginning to level off. Most MDC urban areas underwent dramatic urban growth during the nineteenth and early twentieth centuries. Today, many urban areas in developing are experiencing similar demographic expansion. In 1995, the percent urban share of total population in Asia and Africa was about 35%. By the year 2025 the percent urban population is expected to rise to about 55% in these regions.

People are generally moving into urban areas to find a better way of life. Cities have supplied people with jobs, education, culture, health care, trade, and commerce. Cities are often favored by government policies which encourage industrial development and its monetary rewards. People from rural areas have also been forced to move to cities due to overpopulation and because the mechanization of agriculture has left many people unemployed.

### **Urbanization, Humans and the Environment**

Worldwide more people now live in urban environments than rural. The migration of humans from rural to urban areas is predicted to continue for another 50 to 100 years into the future, especially in developing countries. Urbanization can lead to environmental degradation in three general ways:

- The conversion of land from natural habitats to urban built areas.
- Extraction and depletion of natural resources. Growing urban areas often require more resources than the local area can supply. Cities therefore, not only deplete local resources, but they can also deplete natural resources great distances away.
- The production and disposal of wastes in the Earth's atmosphere, hydrosphere and on the surface of the lithosphere.

Some of the effects of these problems is the result of too many people. Other effects are related to the activities that take place in cities, like industrialization.

### **Urbanization and the Atmosphere**

Urbanization can alter the nature of the atmosphere. Temperature and precipitation patterns can be modified because of urbanization. The temperature of a city is often warmer than that of surrounding rural areas. Because of this, cities are often referred to as urban heat islands. As an urban area grows, a heat island can develop impacting regional climate. Temperature increases result from the fact that the materials used to construct built structures in cities conduct more heat than vegetated areas. Buildings and vehicles also release a significant amount of heat energy because of the combustion of fossil fuels used to create space heat and run engines.

Urban climates are generally cloudier and experience more precipitation than their rural counterparts. The air pollution, associated with large cities provides many particles that act as condensation nuclei for cloud droplet formation, influencing cloud and precipitation development. In addition, convection currents associated with urban heat islands can enhance the formation of clouds.

Air pollution is a major problem associated with most urban areas. It is believed that more than 1.1 billion people reside in cities with extremely poor air quality. Sources of air pollution include industrial and vehicle emissions and energy production. Often, energy use per capita is less in an urbanized area than in a rural area due to energy efficient apartments, attached housing and mass transit. The sheer number of people involved, however, still makes urban areas major contributors to air pollution. Some problems include photochemical smog, acid deposition, and the enhancement of the green house effect. One scientific study has revealed that 40% of the total North American carbon dioxide emissions originated from only 50 urban areas. The circulation patterns associated with an urban heat island tends to create a dome over the city that traps pollutants. Concentrations of pollutants in cities, like suspended particulate matter, can be thousands of times greater than in rural areas.

### **Urbanization and the Hydrosphere**

Urbanization completely alters the surface properties of an area causing severe changes to local surface and subsurface hydrology. Roads, parking lots and buildings do not absorb precipitation as well as vegetation and soil, increasing the potential for runoff and severe flooding. In natural environments, rain water is either intercepted by vegetation or it can infiltrate into the soil layer. Much of this water is then used in the process of evapo-transpiration which cools the Earth's surface. In many urban areas, water often quickly drains from streets into storm sewers reducing its ability to cool the local environment. Often wetlands are completely altered in urban environments. Wetlands have a natural ability to regulate water flow and act to purify water of pollutants and sediment.

### **Urbanization and the Lithosphere**

Approximately 1% of the Earth's total terrestrial surface is now urbanized. The conversion of a natural landscape to an urban area is essentially an irreversible process. In most cases, urban land conversion results in complete alteration in the physical and biotic character of the Earth's land surface. In many areas of the world, urban expansion is rapidly consuming natural habitat and valuable cropland as the populations of urban centers increase.

Often agriculture and cities develop in similar regions. Unfortunately, expanding urban areas are consuming agricultural land. This is a particularly important problem in India. The common name given to this type of land use change is urban sprawl.

Urbanization also impacts the soil layer. Development of urban built areas often cause soil to be covered by cement, asphalt of buildings. Emissions from vehicles can contaminate soils with cadmium, lead, nickel, oil and grease. Salt applied in the winter to reduce ice and snow on roads can reduce the fertility of urban soils.

### **Solid Waste & Management**

Any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining and agricultural operations, and from community activities is called solid waste.

#### **Types of solid waste**

**A.** Solid waste can be classified into different types depending on their source :

- I. Household waste is generally classified as municipal waste
- II. Industrial waste as hazardous waste
- III. Biomedical waste or hospital waste as infectious waste.

**I. Municipal Solid Waste :** The term 'municipal solid waste' means all waste materials discarded for disposal by households, including single and multifamily residences, and hotels and motels. This garbage is generated mainly from residential and



commercial complexes. With rising urbanization and change in lifestyle and food habits, the amount of municipal solid waste has been increasing rapidly and its composition changing.

Garbage is mainly categories into the four broad areas :

**Organic waste :** kitchen waste, vegetables, flowers, leaves, fruits.

**Toxic waste :** old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish.

**Recyclable :** paper, glass, metals, plastics.

**Soiled:** hospital waste such as cloth soiled with blood and other body fluids.

**II. Hazardous Waste :** Industrial and hospital waste is considered hazardous as they may contain toxic substances. Certain types of household waste are also hazardous. Hazardous wastes could be highly toxic to humans, animals, and plants; are corrosive, highly inflammable, or explosive; and react when exposed to certain things e.g. gases. India generates around 7 million tonnes of hazardous wastes every year, most of which is concentrated in four states: Andhra Pradesh, Bihar, Uttar Pradesh, and Tamil Nadu.

Household waste that can be categorized as hazardous waste include old batteries, shoe polish, paint tins, old medicines, and medicine bottles. In the industrial sector, the major generators of hazardous waste are the metal, chemical, paper, pesticide, dye, refining, and rubber goods industries.

**III. Hospital waste :** Hospital waste is generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities in these fields or in the production or testing of biologicals. It may include wastes like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc. These are in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be a serious threat to human health if not managed in a scientific and discriminate manner.

**B. Solid waste** can be classified into different types depending on waste type:

I. Recyclable

II. Toxic Waste

III. Green Waste

**I. Recyclable :** Recyclable waste, objects which are useful, but no longer wanted. Solid waste management includes the construction of facilities to recycle these goods, which include scrap metal, glass, cans, paper, plastics, wood, and similar materials.

**II. Toxic Waste :** Waste which could potentially contaminate the environment, meaning that it needs to be handled with care. This category includes electronic waste, a growing problem in many industrialized nations.

**III. Green Waste :** green waste such as compost and yard clippings. People with land can compost their own green waste, and many cities collect it separately from true garbage, the final category, so that the green waste can be composted and returned to the earth.

## Solid waste Management

Solid waste management is a system for handling all of this garbage; municipal waste collection is solid waste management, as are recycling programs, dumps, and incinerators. Four Rs (Refuse, Reuse, Recycle, Reduce ) to be followed for waste management

**I. Refuse :** Instead of buying new containers from the market, use the ones that are in the house. Refuse to buy new items though you may think they are prettier than the ones you already have.

**II. Reuse :** Do not throw away the soft drink cans or the bottles; cover them with homemade paper or paint on them and use them as pencil stands or small vases.

**III. Recycle :** Use shopping bags made of cloth or jute, which can be used over and over again [will this come under recycle or reduce? Segregate your waste to make sure that it is collected and taken for recycling.

**IV. Reduce :** Reduce the generation of unnecessary waste, e.g. carry your own shopping bag when you go to the market and put all your purchases directly into it.

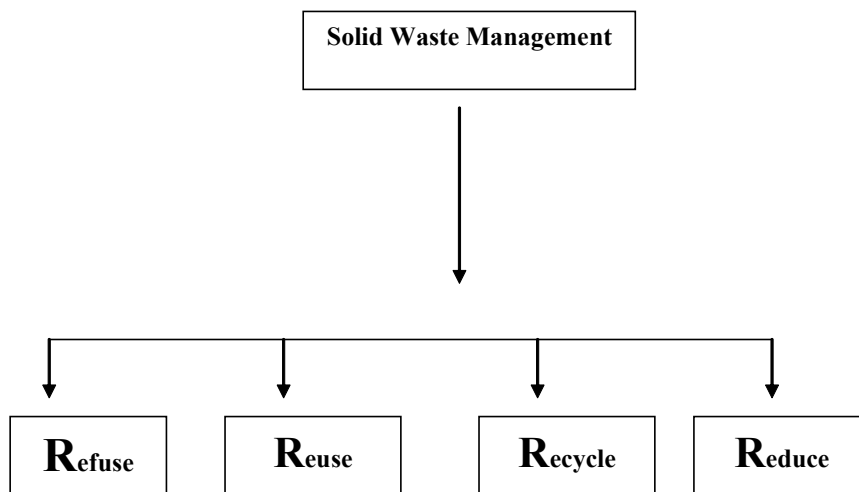


Fig. 10.2. Four R's to be followed for waste management

## Healthcare Waste and its Management

Most waste generated in healthcare establishments can be treated as regular solid municipal waste. But a varying proportion of healthcare waste (HCW) requires special attention, including sharps (e.g. needles, razors, scalpels), pathological waste, other potentially infectious waste, pharmaceutical waste, biological waste, and hazardous chemical waste. Collectively, these wastes are known as “special healthcare waste”. In addition, all waste generated under certain circumstances, such as in isolation wards and microbiological laboratories, requires special attention.

The mismanagement of healthcare waste poses risks to people and the environment. Healthcare workers, patients, waste handlers, waste pickers, and the general public are exposed to health risks from infectious waste (particularly sharps), chemicals, and other special HCW. Improper disposal of special HCW, including open dumping and uncontrolled burning, increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion. Transmission of disease generally occurs through injuries from contaminated sharps. Infections of particular concern are Hepatitis B (HBV), Hepatitis C (HCV), and the human immunodeficiency virus (HIV). HBV, for example, can remain infectious for a week, even dried at room temperature, and the probability that a single needle stick will result in sero2 conversion is approximately 30 percent. For HIV and HCV, the probability that a single needle stick will result in sero-conversion is 0.3-0.5 percent and 2-5 percent, respectively (WHO, 1997). For these reasons, occupational health and safety should be a component of HCW management plans.

**Table 10.1. Different Source of Solid Waste**

Source	Typical waste generators	Types of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Institutional	Schools, hospitals, prisons, government centers.	Same as commercial
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (Manufacturing etc)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay, tailings.
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).

**Conclusion**

**Urbanization as a Social Problem** How is urbanization negatively effecting our society? The answer to this question is not a simple one. One must understand that urbanization, can not be stopped, but only contained in a manner that will help the nations to function better as a country. The more densely populated and more heterogeneous a community is, the more accentuated characteristics can be associated with urbanism. Urbanism causes decrease in per capita, and promotes urban violence, political instability, crime and aggressive behavior. Rapid population growth in urban areas also perpetuates poverty. Another major issue being created by this social problem is the breaking of the traditional family structure. Our cities are not working well. Sanitation, safety, transportation, housing, education and even electricity are failing. These are all responsibilities of the government or it is at least their job to regulate these services deemed to be monopolies.

**SHORT ANSWER**

1. Define the Urbanization.
2. How the urbanization is effecting Hydrosphere and Lithosphere?
3. Discuss the types of solid wastes found in environment.
4. What are the major sources of solid waste?
5. Is Air pollution is connected with Urbanization?
6. What do you know about recyclable materials?
7. What is Green waste?
8. Which type of solid waste is produced by Residential sources?
9. How construction and demolition industry produce solid waste?
10. What is the meaning of organic waste?

**LONG ANSWER**

1. Discuss negative impacts of urbanization.
2. How the solid waste can be managed?
3. Discuss the healthcare waste and its management.
4. Discuss the four R's of solid waste.
5. What are the reasons behind the urbanization?
6. How the industrial solid waste can be managed?
7. Can Recycling minimize the impact of urbanization?
8. Discuss the waste of hospital waste on ecosystem.
9. How the agriculture sector produce solid waste?
10. Urbanization is a necessary evil. Explain.

**TRUE/FALSE**

1. Recyclable waste are the objects which are useful but no longer wanted.
2. Industrial waste is hazardous waste.
3. In 2025 about 85% of world's population will reside in urban areas.
4. Paper and glass can be recycled.
5. Solid waste can be classified into three types.
6. Light and heavy manufacturing plants produce demolition materials.
7. Orchards are the part of Agricultural waste.
8. WHO guideline have been released in 2005.
9. Compost and yard clipping are green waste.
10. Mobile phone batteries can be recycled.

**FILL IN THE BLANKS**

1. Urbanized area are mainly suffered by \_\_\_\_\_ pollution.
2. \_\_\_\_\_ % of the earth is the total terrestrial surface is now urbanized.
3. Hospital waste are \_\_\_\_\_ waste.
4. Fertilizers are considered as \_\_\_\_\_ waste.
5. Compost and yard clipping are \_\_\_\_\_ waste.
6. Cities with population greater than \_\_\_\_\_ million are called as mega cities.
7. \_\_\_\_\_ % of the earth's human population are located in Urban areas.
8. More than \_\_\_\_\_ billion people reside in extremely poor air quality.
9. Solid waste can be classified in \_\_\_\_\_ categories.
10. Garbage can be of \_\_\_\_\_ types.

## CHAPTER

# 11

## Global Warming and Climate Change

**Global warming** is a term used to describe an increase over time of the average temperature of Earth's atmosphere and oceans. Global warming theories attempt to account for the rise in average global temperatures since the late 19th century ( $0.6 \pm 0.2^{\circ}\text{C}$ ) and assess the extent to which the effects are due to human causes. The most common global warming theories attribute temperature increases to increases in the greenhouse effect caused primarily by anthropogenic (human-generated) carbon dioxide.

### Cause of Global warming

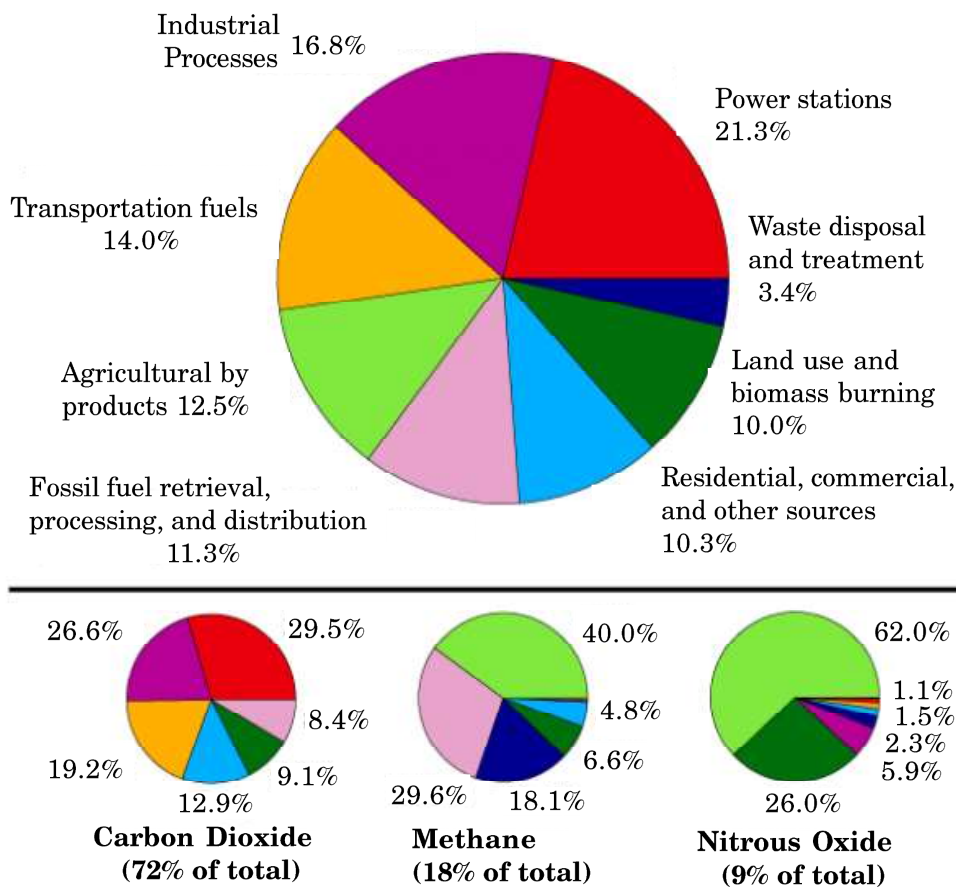
Almost 100% of the observed temperature increase over the last 50 years has been due to the increase in the atmosphere of greenhouse gas concentrations like water vapour, carbon dioxide ( $\text{CO}_2$ ), methane and ozone. Greenhouse gases are those gases that contribute to the greenhouse effect. The largest contributing source of greenhouse gas is the burning of fossil fuels leading to the emission of carbon dioxide.

### The Greenhouse Effect

When sunlight reaches Earth's surface some is absorbed and warms the earth and most of the rest is radiated back to the atmosphere at a longer wavelength than the sun light. Some of these longer wavelengths are absorbed by greenhouse gases in the atmosphere before they are lost to space. The absorption of this long wave radiant energy warms the atmosphere. These greenhouse gases act like a mirror and reflect back to the Earth some of the heat energy which would otherwise be lost to space. The reflecting back of heat energy by the atmosphere is called the "greenhouse effect".

The major natural greenhouse gases are water vapor, which causes about 36-70% of the greenhouse effect on Earth (not including clouds); carbon dioxide  $\text{CO}_2$ , which causes 9-26%; methane, which causes 4-9%, and ozone, which causes 3-7%. It is not possible to state that a certain gas causes a certain percentage of the greenhouse effect, because the influences of the various gases are not additive. Other greenhouse gases include, but are not limited to, nitrous oxide, sulfur hexafluoride, hydro-fluorocarbons, per-fluorocarbons and chlorofluorocarbons.

### Annual Greenhouse Gas Emissions by Sector



**Fig. 11.1 Annual green house gas emission by various sectors**

#### Impact of Global warming

Increasing global temperatures are causing a broad range of changes. Sea levels are rising due to thermal expansion of the ocean, in addition to melting of land ice. Amounts and patterns of precipitation are changing. The total annual power of hurricanes has already increased markedly since 1975 because their average intensity and average duration have increased (in addition, there has been a high correlation of hurricane power with tropical sea-surface temperature).

Changes in temperature and precipitation patterns increase the frequency, duration, and intensity of other extreme weather events, such as floods, droughts, heat waves, and tornadoes. Other effects of global warming include higher or lower agricultural yields,

further glacial retreat, reduced summer stream flows, species extinctions. As a further effect of global warming, diseases like malaria are returning into areas where they have been extinguished earlier.

The impact of the global-warming can also be explained by following headings :

**1. Most places will continue to get warmer :** Especially at night and in winter. The temperature change will benefit some regions while harming others, for example, patterns of tourism will shift. The warmer winters will improve health and agriculture in some areas, but globally, mortality will rise and food supplies will be endangered due to more frequent and extreme summer heat waves and other effects. Regions not directly harmed will suffer indirectly from higher food prices and a press of refugees from afflicted regions.

**2. Sea levels will continue to rise for many centuries :** The last time the planet was 3°C warmer than now, the sea level was roughly 5 meters higher. That submerged coastlines where many millions of people now live, including cities from New York to Shanghai. The rise will probably be so gradual that later generations can simply abandon their parents' homes, but a ruinously swift rise cannot be entirely ruled out. Meanwhile storm surges will cause emergencies.

**3. Weather patterns will keep changing :** Toward an intensified water cycle with stronger floods and droughts. Most regions now subject to droughts will probably get drier (because of warmth as well as less precipitation), and most wet regions will get wetter. Extreme weather events will become more frequent and worse. In particular, storms with more intense rainfall are liable to bring worse floods. Mountain glaciers and winter snow-pack will shrink, jeopardizing many water supply systems. Each of these things has already begun to happen in some regions.

**4. Ecosystems will be stressed :** Although some managed agricultural and forestry systems will benefit, at least in the early decades of warming. Uncounted valuable species, especially in the Arctic, mountain areas, and tropical seas, must shift their ranges. Many that cannot will face extinction. A variety of pests and tropical diseases are expected to spread to warmed regions. Each of these problems has already been observed in numerous places.

**5. Increased carbon dioxide levels will affect biological systems :** Independent of climate change. Some crops will be fertilized, as will some invasive weeds (the balance of benefit vs. harm is uncertain). The oceans will continue to become markedly more acidic, gravely endangering coral reefs, and probably harming fisheries and other marine life.

## **How to Control Global Warming**

**Replace frequently used light bulbs with compact fluorescent bulbs :** The new bulbs will last longer and use less energy, which means less pollution from power plants. If you replaced just two incandescent bulbs with compact fluorescents, your household would save about 300 pounds of carbon dioxide per year. If every household in the earth did it, we would save a trillion pounds of greenhouse gases from entering the atmosphere.



**Improve your hot-water setup :** Wrapping your water heater it in an insulating jacket will result in a 1,000 pound per year reduction of carbon dioxide emissions. If you keep your water heater thermostat no higher than 120 degrees F, you can reduce carbon dioxide emissions by 550 pounds per year. Another water-heating option that can improve efficiency, especially if you have long runs of hot-water pipes going to your most-used sinks, is the tank-less water heater. This device heats the water needed at an individual sink “on demand” rather than keeping a large central tank of water hot ready for all sinks at all times. This is usually more efficient, and also gives you an “unlimited” supply of hot water for the affected sinks (and showers/tubs). The best choice in getting energy-smart on hot water is a solar hot water heater.

**Don’t leave the water running :** It’s always a good idea to turn off the water when you’re not actually using it. When hot water is involved, minimizing water usage also reduces energy usage. For example, when you’re washing your hands, soaping up in the shower, or doing dishes in the kitchen sink—turn off the water until you actually need it for rinsing. Another way to reduce hot-water usage is to take shorter showers. Similarly, installing a low-flow shower head can save 350 pounds of carbon dioxide per year.

**Replace old appliances :** Get rid of old, energy-inefficient appliances and replace them with newer energy-efficient models. Just by using an energy-efficient refrigerator, you can save 500 pounds of carbon dioxide per year. If you replace your current washing machine with a low-energy, low-water-use machine, you will be able to reduce your carbon dioxide emissions by 440 pounds per year. For even more savings, wash your laundry in warm or cold water (instead of hot). That will bring in a reduction of carbon dioxide emissions of about 500 pounds per year.

**Bring back the clothes line :** Using an energy-efficient clothes dryer is good, but not using a dryer at all is better. Air dry your clothes during the spring and summer instead of using the dryer. You can save 700 pounds of carbon dioxide per year if you do this during the warmest six months of the year.

**Keep your vehicle in tip top condition :** A tune-up can boost your miles per gallon from 4% to 40%. A new air filter can get you 10% more miles per gallon.

**Check your tires weekly and make sure they are properly inflated :** It’s safer and saves fuel. If everyone in the United States did it, gasoline use nationwide would come down by 2%.

**Un-Car :** Carpool or take mass transit to work sometimes. Leaving your car at home just two days a week will reduce your carbon dioxide emissions by an average of 1,590 pounds per year.

**Reduce garbage :** Producing 2% less garbage will reduce carbon dioxide emissions by 1,000 pounds per year. Add “less packaging” to your list of reasons for choosing one item over another. Bring your own cloth bags to the market or reuse the paper bags they give you.

**Support recycling :** Producing new paper, glass, and metal products from recycled materials avoids 70% to 90% of the energy and pollution that results from products made from virgin materials. You can save 2,400 pounds of carbon dioxide per year by recycling half of household-generated waste. Recycle at home and promote recycling programs at your school or workplace.

### **Climate Change and its Impact**

A study dealing with variations in climate on many different time scales from decades to millions of years, and the possible causes of such variations. In the most general sense, the term “climate change” encompasses all forms of climatic inconstancy (that is, any differences between long-term statistics of the meteorological elements calculated for different periods but relating to the same area) regardless of their statistical nature or physical causes.

Climate change may result from such factors as changes in solar activity, long-period changes in the Earth’s orbital elements (eccentricity, obliquity of the ecliptic, precession of equinoxes), natural internal processes of the climate system, or anthropogenic forcing (for example, increasing atmospheric concentrations of carbon dioxide and other greenhouse gases).

The term “climate change” is often used in a more restricted sense, to denote a significant change (such as a change having important economic, environmental and social effects) in the mean values of a meteorological element (in particular temperature or amount of precipitation) in the course of a certain period of time, where the means are taken over periods of the order of a decade or longer.

### **Cause of Climate Change**

During the twentieth century, the earth’s surface warmed by about 1.4 °F. There are a variety of potential causes for global climate change, including natural and human-induced mechanisms. Science has made great strides recently in determining which potential causes are responsible for the climate change that occurred during the twentieth century, providing strong evidence that greenhouse gases released to the atmosphere by human activities are the main cause of climate change:-

1. Transportation
2. Industrialization
3. De-forestation
4. Rapid Urbanization

### **Impacts of Climate Change on Various Sectors**

**Water Resources :** It is projected that quantity of surface run off due to climate change would vary across the river basins as well as sub basins of major rivers. However, there is a general reduction in the quantity of the available run off.

**Forestry and Natural Ecosystems :** The emerging results of analysis of impacts of climate change on forest biomes in India seem to be highly vulnerable to the projected change in climate. Majority of the vegetation in India is likely to be less optimally adapted to its existing location and consequently vulnerable to the adverse climatic changes. Biodiversity is also likely to be adversely impacted due to this.

**Human health :** Increase in temperature is projected to enhance the occurrence and spread on vector borne diseases such as Malaria. Malaria incidences are directly linked to the generation of vectors which are sensitive to temperature, precipitation and humidity conditions. In the climate change context, more states may offer climate opportunities for malaria vector breeding throughout the year. These opportunities are projected to increase by 3-5 months in northern states and may reduce by 2-3 months in the southern states.

**Infrastructure :** Large infrastructure such as dams, roads, bridges incurring high costs of construction are vulnerable to extreme events like cyclones, heavy rains, landslides and floods, which may increase in the later half of the century due to climate change. At that time, the currently commissioned infrastructure having lived its normal life span would be more vulnerable to these recurrent events.

**Coastal Zones :** The holistic data of sea level reveals a high variability along the Indian coast line with an increase along the Gulf of Kutchh and West Bengal coast line and decrease along Karnataka coast. The observations indicate a long term average rising end of 1 mm/year in sea level and a projection of rise in sea level in the range of 46-59 cm by the end of twenty first century. The result of a preliminary assessment indicates the vulnerability of Indian coast lines due to sea level rise, Tectonic movement, prevalent hydrography and physio-geography.

**Agriculture :** Gaseous emissions and climate change can adversely affect agriculture in India. While high CO<sub>2</sub> can result in growth and increase in plant biomass, high ambient temperature resulting from increased emission can reduce the crop yields. Studies indicate that effect of increased temperature can substantially reduce yields of cereals apart from affecting their quality. Secondary impact of changed pest and disease scenario can further complicate the crop yield situation. Variable impacts of climate change on agriculture have been projected. For instance, increase in CO<sub>2</sub> concentration, increase in temperature and variable distribution of rainfall show a mixed projection of yields of various crops across regions.

### **How to Reduce the Climate Change**

The time has come when we have learn how to reduce climate change, and put them into practice now, before it is too late, because climate change today is very much linked to global warming, efforts to fight climate change is very much about reducing the greenhouse gases in our atmosphere and global warming. Some of them are discussed below :

**Cleaner alternative energy sources :** One important way to fight climate change is to use alternative sources of renewable energy which will not release harmful emissions.

Some of these cleaner sources of renewable energy include wind energy, solar energy, water or hydropower, biomass, and geothermal energy. Read more about these renewable energy sources and get the latest news on solar training programs from around the world.

By reducing our reliance on and usage of fossil fuels, and tapping on alternative and greener sources of energy, not only are we helping to reduce the release of greenhouse gases (especially carbon dioxide) into the atmosphere, and hence helping to reduce global warming and fight climate change, we are also helping to ensure the sustainability of the world's living and development.

### **Energy Saving**

But before we discover reliable and sustainable green energy sources that we can tap on effectively, we need to learn how to conserve our energy sources. (Even if we discover the green energy sources to last us forever, it is still a good value to not be wasteful).

To do so, we can adopt energy saving tips like using energy-saving appliances like the compact fluorescent light (CFL) bulbs, switching off our electrical appliances when they are not in use.

### **Green Driving**

Given the number of automobiles in the world today, they emit a substantial amount of greenhouse gases and contribute significantly to global warming and climate change. In fact, after coal-burning power plants, automobiles are the second largest source of carbon dioxide.

Which is why cutting greenhouse gas emissions from automobiles is a critical strategy to fighting global warming and climate change. The best strategy on how to reduce climate change is definitely to reduce the use of automobiles. Use public transport or carpool if you can, instead of driving your own car. This is because the amount of pollution created when you drive by yourself (as opposed to carpooling or driving others) can be as bad as taking the plane.

If you must drive, then use an eco-friendly and fuel efficient car, and ensure that your vehicle's engine is working in impeccable condition at all times. A car in poor working condition uses more fuel for the same mileage covered, and releases more carbon dioxide and exhaust gases. Also, adopt green driving tips.

### **Green Shopping**

One point on how to reduce climate change through green shopping tips is to buy local products instead of those produced overseas.

Transporting exotic fruits and vegetables from one destination to another requires a lot of energy, usually from the burning of fossil fuel, which contributes to greenhouse

gas emissions and global warming. Moreover, in attempts to keep the fruits and vegetables fresh, chemical pesticides and preservatives are used, which again contribute to toxins and greenhouse gases being released into the atmosphere.

Hence, buy local produces if you can – not only do they leave less carbon footprints and are cheaper, they are also healthier.

### **Reduce, Reuse & Recycle practices**

The culture of consumerism today encourages people to buy and throw, with little consideration for the impact of such unsustainable consumption on the world. For each item that we purchase and use, energy and resources are used in its manufacture, packaging, transportation and retail, and ultimately its disposal. Pollution is created each step of the process, and substantial greenhouse gases are also released.

If we are to live a sustainable and green life, leaving minimal carbon footpaths during our passage through this earth, we need to resist the culture of consumerism, and instead adopt a lifestyle guided by the Reduce Reuse Recycle principle.

**Reducing, Reusing and Recycling** help us conserve resources and energy, and reduce pollution and greenhouse gas emissions produced, for example in the raw material extraction and disposal processes. In turn, reducing our greenhouse gas emissions substantially would help us reduce global warming and fight climate change. Read more about the benefits of recycling.

### **Re-forestation**

The cleanest and most efficient remover of carbon dioxide from our atmosphere actually comes free. This remover is a gift from nature – our green plants and trees.

“Unfortunately, we have taken this gift for granted”

The rate at which we are cutting down our trees and forests to make way for human developments has greatly reduced the earth’s ability to remove carbon dioxide from the atmosphere. This has in turn contributed to a faster rate of global warming and climate change.

- Take part in your local community’s plant-a-tree effort. Grow an organic garden of your own.
- Reduce your usage of paper – paper production is one main cause of deforestation. But if you must, use recycled paper.

### **Awareness about the Global Warming**

While it is important that we start practicing green living tips and fight climate change from this moment, it is not enough.

We need many more others to join us in this important and meaningful journey.

We need to help others (especially those who are not already convinced) become aware of the seriousness of the climate change issue, as well as help them realize that there are things they can do to make a difference.

In fact, schools and institutions also have an important part to play in this process of education – educating our children on the importance of protecting the earth will help us (and them) secure the future of the planet.

So talk to your children today about going green and fighting climate change. Discuss with other parents on how the message can be more effectively communicated to the children. Talk to your children's teachers and help identify creative ways of encouraging youths in your community to go green.

### **Conclusion**

The planet is warming, from North Pole to South Pole, and everywhere in between. Globally, the mercury is already up more than 1 degree Fahrenheit (0.8 degree Celsius), and even more in sensitive polar regions. And the effects of rising temperatures aren't waiting for some far-flung future. They're happening right now. Signs are appearing all over, and some of them are surprising. The heat is not only melting glaciers and sea ice, it's also shifting precipitation patterns and setting animals on the move.

### **SHORT ANSWER**

1. What is global warming?
2. What is greenhouse effect?
3. What are the impacts of global warming?
4. Explain the causes of climate change.
5. What do you know about the green driving?
6. What do you know about the green shopping?
7. How the re-forestation can be effective in global warming?
8. Give the percentage wise green house emission of various sectors.
9. Can global warming increases the sea-level and how?
10. Is increased temperature affecting the biological factors of ecosystem?

### **LONG ANSWER**

1. Explain how the climate is changing and what are the impacts of it.
2. How the impacts of climate change can be minimized?
3. How reforestation can control the global warming?
4. How we can aware the common man about the impacts of global warming?
5. What do you understand by stressed ecosystem?

6. How the global warming can be controlled?
7. Discuss the current scenario of climate change.
8. How the climate change can damage human health?
9. How the “Reducing, Reusing and Recycling” concept can be beneficial in Global warming?
10. How the common man can be make aware about the global warming?

### TRUE/FALSE

1. CFL's are the most effect way to save energy.
2. Water vapors are the natural gases causing the green house effect.
3. Unleaded petrol can reduce the global warming.
4. Chemical formula of ozone is  $O_4$ .
5. Anthropogenic activities are caused by oil rigs.
6. Chlorofluorocarbons cause green hose effect.
7. Tube-lights are more energy saver than Green House effect.
8. The earth summit in 1992 at Rio de Janeiro.
9. The term ecosystem was given by Tanley.
10. CFL's stands for compact fluorescent light.

### FILL IN THE BLANKS

1. In 20<sup>th</sup> century the earth's surface warmed by about \_\_\_\_\_ °F.
2. \_\_\_\_\_ gas is main reason of global warming.
3. Due to global warming the temperature of the earth is \_\_\_\_\_.
4. Green house effect is cause by \_\_\_\_\_.
5. The major natural green house gasses are \_\_\_\_\_.
6. Fossil fuel produce \_\_\_\_\_ % of green house gas.
7. Methane cause \_\_\_\_\_ % greenhouse effect.
8. Reflecting back of heat energy is called \_\_\_\_\_.
9. Biomass burning cause \_\_\_\_\_ % of green house effect.
10. Ozone layer protects earth from \_\_\_\_\_ radiation.

## CHAPTER

# 12

## Environmental Protection and Acts

There is an ongoing debate about the appropriate role of government for solving environmental problems, with many environmentalists calling for increased government intervention and many people more predisposed to individual responsibility calling for less.

Environmental Law, those areas of law, national, regional and international which are aimed at the protection of the environment. Core elements of environmental law include the control of pollution from man-made sources and the protection of natural resources such as wildlife and natural landscapes, but the precise boundaries of the subject are difficult to draw, and many areas of law such as health and safety at work, land-use planning, and the protection of the man-made cultural heritage have environmental implications.

One area of environmental law concerns the principles under which someone who damages the environment should be liable to pay compensation for so doing, and who can bring a legal action before the courts in such cases. Though important, such principles may do little to prevent environmental damage, and most environmental law now consists of various forms of government regulation. A wide variety of legal approaches are employed, including the banning or restriction of the use of certain substances, and the setting of standards for products. Probably the most widely adopted method of environmental regulation is the requirement for licenses or other forms of consent for the carrying out of specified activities such as the discharge of effluent into water or the disposal of waste. Effective enforcement of environmental laws remains a problem in many jurisdictions, and greater attention is now being paid to use of economic instruments such as special taxes as a means of reinforcing or replacing more conventional means of environmental regulation.

Despite the wide variety of environmental laws that are to be found, a number of common principles and trends are emerging in many jurisdictions, reinforced by increased international cooperation since the 1970s. The need to prevent environmental damage



at source is often reinforced by the requirement of environmental impact assessment procedures designed to provide a systematic prediction of likely environmental impacts from new developments and proposals. The so-called “precautionary principle” emerged in the 1980s as a justification for environmental regulation even where there was still scientific uncertainty about the precise causes of environmental damage, and was endorsed at the 1992 Earth Summit Conference.

The need to ensure greater consistency between disparate environmental laws, and to achieve more effective integration of environmental concerns into other fields of law such as transport and trade remains a continuing challenge. Here are some major environment protection acts in India, discussed below:-

The Environment (Protection) Act, 1986.

### **Chapter I (Preliminary)**

1. Short title, extent and commencement
2. Definitions

**Environment :** This term includes water, air and land and the interrelationship which exists among and between water, air, land and human beings.

**Environmental Pollution :** Means the presence in the environment of any environmental pollutants.

**Environmental Pollutants :** Means any solid liquid or gaseous substance present in such concentration as may be, or tend to be injurious to environment.

**Hazardous Substance :** Means any substance and preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plants, micro-organisms, property or the environment.

### **Chapter II (Reserved Forests)**

1. Power of Central Government to take measures to protect and improve environment.
2. Appointment of officers and their powers and functions.
3. Power to give directions.
4. Rules to regulate environmental pollution.

### **Chapter III (Prevention, Control and Abatement of Environmental Pollution)**

1. Persons carrying on industry, operation, etc. not to allow emission or discharge of environmental pollutants in excess of the standards.
2. Persons handling hazardous substances to comply with procedural safeguard.
3. Furnishing of information to authorities and agencies in certain cases.
4. Power of entry and inspection.

5. Power to take sample and procedure to be followed in connection therewith.
6. Environmental Laboratories.
7. Government analysts.
8. Reports of Government analysts.
9. Penalty for contravention of the provisions of the act and the rules, orders and directions
10. Offences by companies.
11. Offences by Government Departments.

#### **Chapter IV (Miscellaneous)**

1. Protection of action taken in good faith.
2. Cognizance of offences.
3. Information, Reports or Returns.
4. Members, Officers and Employees of the authority constituted under section 3 to be public servants
5. Bar of Jurisdiction.
6. Power to delegate.
7. Effect of other laws.
8. Power to make rules.
9. Rules made under this act to be laid before parliament.

#### **Air (Prevention and Control of Pollution) Act 1981**

Air (Prevention and Control of Pollution) Act 1981 provided for prevention, control and abatement of air pollution and preserving the air quality in the country. Air (Prevention and Control of Pollution) act, 1981 was amended in 1987. It was done with the following purposes :

1. To remove the difficulties encountered during implementation,
2. To confer more powers on the implementing agencies,
3. To impose more stringent penalties for violation of the provisions of the act.
4. To amend the definition of air pollutants to include noise.

#### **Water (Prevention and Control of Pollution) Act 1974**

Water (Prevention and Control of Pollution) Act 1974 concentrates on the following aspects:

1. Restoration and maintenance of wholesomeness and cleanliness in our national aquatic resources by prevention and control of pollution.

2. Central and State Pollution control boards were established for the purpose:-

- (a) To advise the central government on water pollution issues,
- (b) To co-ordinate the activities of the state Pollution Control Boards,
- (c) To sponsor research projects related to water pollution,
- (d) To develop a comprehensive plan for prevention and control of water pollution.

Water (Prevention and Control of Pollution) Act 1974 was amended in 1988. Main amendments were as under :

- 1. Step was taken to rename the Central/State Boards for prevention and Control of Water Pollution as Central/State Pollution Control Boards.
- 2. The Boards have been given powers to close or stop supply of water and electricity to offending establishment.
- 3. The citizens may file criminal complaints against offenders after 60 days notice to boards.
- 4. Even at the time of establishment if industry the person will have to take consent of the board.

### **The Wildlife (Protection) Act, 1972 (No. 53 of 1972) (9th September, 1972)**

An Act to provide for the protection of [Wild animals, birds and plants] and for matters connected therewith or ancillary or incidental thereto.

#### **Chapter 1 (Preliminary)**

##### **1. Short title, extent, and commencement**

- 1. This Act may be called the Wildlife (Protection) Act, 1972.
- 2. It extends to the whole of India, except the State of Jammu and Kashmir.
- 3. It shall come into force in a State or Union Territory to which it extends, on such date as the Central Government may, by notification, appoint, and different dates may be appointed for different provision of this Act or for different States or Union Territories.

**2. Definitions :** In this Act, unless the context otherwise requires :

- 1. “animal” includes amphibians, birds, mammals, and reptiles, and their young, and also includes, in the cases of birds and reptiles, their eggs,
- 2. “animal article” means an article made from any captive animal or wild animal, other than vermin, and includes an article or object in which the whole or any part of such animal.
- 3. “Board means the Wildlife Advisory Board constituted under subsection (1) of Sec. 6;
- 4. “captive animal” means any animal, specified in Schedule 1, Schedule II, Schedule III or Schedule IV, which is captured or kept or bred in captivity;

5. "Chief Wildlife Warden" means the person appointed as such under C1. (a) of sub-section (1) of Sec.4;
6. "Circus" means an establishment, whether stationary or mobile where animals are kept or used wholly or mainly for the purpose of performing tricks or manoeuvres;
7. "Closed area" means the area which is declared under sub-section (1) of Sec.37 to be closed to hunting;
8. "Collector" means the Chief Officer in charge of the revenue administration of a district;
9. "Commencement of this Act", in relation to –
  - (a) a State, means commencement of this Act in that State.
  - (b) any provision of this Act, means commencement of that provision in the concerned State;
10. "Dealer" means any person who carries on the business of buying and selling any captive animal, animal article, trophy, uncurled trophy,
11. "Director" means the person appointed as Director of Wildlife Preservation under Cl (a). of sub-section (1) of Sec. 3;
12. "Forest Officer" means the Forest Officer appointed under clause (2) of Sec.2 of the Indian Forest Act, 1927.
13. "Government property" means property, referred to in sec.39;
14. "Habitat" includes land, water, or vegetation which is the natural home of any wild animal;
15. "Hunting", with its grammatical variations and cognate expressions, includes,
  - (a) Capturing, killing, poisoning, snaring, and trapping or any wild animal and every attempt to do so,
  - (b) Driving any wild animal for any of purposes specified in sub clause
  - (c) Injuring or destroying or taking any part of the body of any such animal, or in the case of wild birds or reptiles, damaging the eggs of such birds or reptiles, or disturbing the eggs or nests of such birds or reptiles;
16. "Land" includes canals, creeks, and other water channels, reservoirs, rivers, streams and lakes, whether artificial or natural, [marshes and wetlands and also includes boulders and rocks.
17. "License" means a license granted under this Act;
18. "Live-stock" includes buffaloes, bulls, bullocks, camels, cows, donkeys, goats, horses, mules, pigs, sheep, yak and also includes their young.
19. "Manufacturer" means a manufacturer of animal articles;

20. "Meat" includes blood, bones, sinew, eggs, fat and flesh, whether raw or cooked, of any wild animal other than vermin;
21. "National Park" means an area declared, whether under sec.35. or sec.38 or deemed, under sub-section (3) of sec.66. to be declared, as a National Park
22. "notification" means a notification published in the official Gazette;
23. "Permit" means a permit granted under this Act or any rule made there under;
24. "Person" includes a firm;
25. "Prescribed" means prescribed by rules made under this Act;
26. "Reserve forest" means the forest declared to be reserved by the State Government under sec.20. of the Indian Forest Act, 1927.
27. "Sanctuary" means an area declared, whether under sec. [26(A)5] or sec 38, or deemed, under sub section (3) of Sec.66 to be declared, as a wildlife sanctuary;
28. "Specified plant" means any plant specified in Schedule VI.
29. Rugs, skins, and specimens of such animals mounted in whole or in part through a process of taxidermy, and antler, horn, rhinoceros horn, feather, nail, tooth, musk, eggs, and nests.
30. "Uncured trophy" means the whole or any part of any captive animal, other than vermin, which has not undergone a process of taxidermy, and includes a freshly killed wild animal ambergris, musk and other animal products.
31. "Weapon" includes ammunition, bows and arrows, explosives, firearms, hooks, knives, nets, poison, snares, traps, and any instrument or apparatus capable of anaesthetizing, decoying, destroying, injuring or killing an animal;
32. "Wild animal" means any animal found wild in nature and includes any animal specified in Schedule I, Schedule II, Schedule, IV or Schedule V, wherever found;
33. "Wildlife" includes any animal, bees butterflies, crustacean, fish and moths; and aquatic or land vegetation which forms part of any habitat;
34. "Zoo" means an establishment, whether stationary or mobile, where captive animals are kept for exhibition to the public but does not include a circus and an establishment of a licensed dealer in captive animals.

### **The Forest (Conservation) Act 1980**

An Act to provide for the conservation of forests and for matters connected therewith or ancillary or incidental thereto.

Be it enacted by Parliament in the Thirty-first year of the Republic of India as follows;

#### **1. Short title, extent and commencement**

1. This Act may be called the Forest (Conservation) Act 1980.
2. It extends to the whole of India except the State of Jammu and Kashmir.
3. It shall be deemed to have come into force on the 25th day of October 1980.

**2. Restriction on the de-reservation of forests or use of forest land for non-forest purpose :** Notwithstanding anything contained in any other law for the time being in force in a State, no State Government or other authority shall make, except with the prior approval of the Central Government, any order directing :

- (i) that any reserved forest (within the meaning of the expression “reserved forest” in any law for the time being in force in that State) or any portion thereof, shall cease to be reserved;
- (ii) that any forest land or any portion thereof may be used for any non-forest purposes;
- (iii) that any forest land or any portion thereof may be assigned by way of lease of otherwise to any private person or to any authority, corporation, agency or any other Organisation not owned, managed or controlled by Government.
- (iv) that any forest land or any portion thereof may be cleared of trees which have grown naturally in that land or portion, for the purpose of using it for deforestation.

**3. Constitution of Advisory Committee:-** The Central Government may constitute a Committee consisting of such number of persons as it in may deem fit to advise that Government with regard to :

- (i) the grant of approval under section 2;
- (ii) any other matter connected with the conservation of forests which may be referred to it by the Central Government.

**3A. Penalty for contravention of the provisions of the Act :** Whenever contravenes or abets the contravention of any of the provisions of section 2, shall be punishable with simple imprisonment for a period which may extend to fifteen days.

**3B. Offences by authorities and Government departments**

- 1. Where any offence under this Act has been committed.
  - (a) by any department of Government the head of the department; or
  - (b) by any authority, every person who, at the time the offence was committed, was directly in charge of and was responsible to, the authority for the conduct of the business of the authority was well as the authority;

**4. Power to make rules**

- 1. The Central Government may by notification in the Official Gazette, makes rules for carrying out the provisions of this Act.
- 2. Every rule made under this Act shall be laid as soon as may be after it is made, before each House of Parliament.

**5. Repeal and saving**

- 1. The Forest (Conservation) Ordinance, 1980 (17 of 1980), is hereby repealed.

2. Notwithstanding such repeal, anything done or any action taken under the provisions of the said Ordinance shall be deemed to have been done or taken under the corresponding provisions of this Act.

## **Environmental Protection Acts in Nutshell**

### **(General)**

**1986 - The Environment (Protection) Act** authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the setting and or operation of any industrial facility on environmental grounds.

**1986 - The Environment (Protection) Rules** lay down procedures for setting standards of emission or discharge of environmental pollutants.

**1989 - The objective of Hazardous Waste (Management and Handling) Rules** is to control the generation, collection, treatment, import, storage, and handling of hazardous waste.

**1989 - The Manufacture, Storage, and Import of Hazardous Rules** define the terms used in this context, and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and isolated storage facilities.

**1989 - The Manufacture, Use, Import, Export, and Storage of hazardous Micro-organisms/ Genetically Engineered Organisms or Cells Rules** were introduced with a view to protect the environment, nature, and health, in connection with the application of gene technology and microorganisms.

**1991 - The Public Liability Insurance Act and Rules and Amendment, 1992** was drawn up to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance.

**1995 - The National Environmental Tribunal Act** has been created to award compensation for damages to persons, property, and the environment arising from any activity involving hazardous substances.

**1997 - The National Environment Appellate Authority Act** has been created to hear appeals with respect to restrictions of areas in which classes of industries etc. are carried out or prescribed subject to certain safeguards under the EPA.

**1998 - The Biomedical waste (Management and Handling) Rules** is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection, and treatment.

**1999 - The Environment (Siting for Industrial Projects) Rules, 1999** lay down detailed provisions relating to areas to be avoided for siting of industries, precautionary measures to be taken for site selecting as also the aspects of environmental protection which should have been incorporated during the implementation of the industrial development projects.

**2000 - The Municipal Solid Wastes (Management and Handling) Rules, 2000** apply to every municipal authority responsible for the collection, segregation, storage, transportation, processing, and disposal of municipal solid wastes.

**2000 - The Ozone Depleting Substances (Regulation and Control) Rules** have been laid down for the regulation of production and consumption of ozone depleting substances.

**2001 - The Batteries (Management and Handling) Rules, 2001** rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, auctioneer, consumer, and bulk consumer involved in the manufacture, processing, sale, purchase, and use of batteries or components so as to regulate and ensure the environmentally safe disposal of used batteries.

**2002 - The Noise Pollution (Regulation and Control) (Amendment) Rules** lay down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10:00 p.m. to 12:00 midnight) on or during any cultural or religious festive occasion.

**2002 - The Biological Diversity Act** is an act to provide for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge associated with it.

### **(Forest and wildlife)**

**1927 - The Indian Forest Act and Amendment, 1984**, is one of the many surviving colonial statutes. It was enacted to 'consolidate the law related to forest, the transit of forest produce, and the duty liable on timber and other forest produce'.

**1972 - The Wildlife Protection Act, Rules 1973 and Amendment 1991** provides for the protection of birds and animals and for all matters that are connected to it whether it be their habitat or the waterhole or the forests that sustain them.

**1980 - The Forest (Conservation) Act and Rules, 1981**, provides for the protection of and the conservation of the forests.

### **(Water)**

**1882 - The Easement Act** allows private rights to use a resource that is, groundwater, by viewing it as an attachment to the land. It also states that all surface water belongs to the state and is a state property.

**1897 - The Indian Fisheries Act** establishes two sets of penal offences whereby the government can sue any person who uses dynamite or other explosive substance in any way (whether coastal or inland) with intent to catch or destroy any fish or poisonous fish in order to kill.

**1956 - The River Boards Act** enables the states to enroll the central government in setting up an Advisory River Board to resolve issues in inter-state cooperation.



**1970 - The Merchant Shipping Act** aims to deal with waste arising from ships along the coastal areas within a specified radius.

**1974 - The Water (Prevention and Control of Pollution) Act** establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent. Polluting industries must seek permission to discharge waste into effluent bodies. The CPCB (Central Pollution Control Board) was constituted under this act.

**1977 - The Water (Prevention and Control of Pollution) Cess Act** provides for the levy and collection of cess or fees on water consuming industries and local authorities.

**1978 - The Water (Prevention and Control of Pollution) Cess Rules** contains the standard definitions and indicate the kind of and location of meters that every consumer of water is required to affix.

**1991 - The Coastal Regulation Zone Notification** puts regulations on various activities, including construction, are regulated. It gives some protection to the backwaters and estuaries.

#### **(Air)**

**1948 – The Factories Act and Amendment in 1987** was the first to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

**1981 - The Air (Prevention and Control of Pollution) Act** provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the CPCB .

**1982 - The Air (Prevention and Control of Pollution) Rules** defines the procedures of the meetings of the Boards and the powers entrusted to them.

**1982 - The Atomic Energy Act** deals with the radioactive waste.

**1987 - The Air (Prevention and Control of Pollution) Amendment Act** empowers the central and state pollution control boards to meet with grave emergencies of air pollution.

**1988 - The Motor Vehicles Act** states that all hazardous waste is to be properly packaged, labelled, and transported.

#### **Conclusion**

Environmental Protection Law and Acts, those areas of law, national, regional and international which are aimed at the protection of the environment. Core elements of environmental protection acts include the control of pollution from man-made sources and the protection of natural resources such as wildlife and natural landscapes, but the precise boundaries of the subject are difficult to draw, and many areas of law such as health and safety at work, land-use planning, and the protection of the man-made cultural heritage have environmental implications.

**LONG ANSWER**

1. Discuss the Environmental Protection Act in detail.
2. What do you know about Environmental Ethics?
3. Why the Biodiversity conservation is needed?
4. Discuss the Air (Prevention and control) Act 1981.
5. Discuss the water (Prevention and control) Act 1974.
6. Discuss the Wildlife (Protection) Act 1972.
7. Elaborate the Forest (conservation) Act 1980.
8. Describe the Noise Pollution Act in detail.
9. Elaborate Indian fisheries act in detail.
10. What do you know about Municipal Solid waste?

**SHORT ANSWER**

1. Discuss the Prevention, control and removal by Environmental Protection Act, 1980.
2. What are the requisites of Reserved Forests formation?
3. Discuss the responsibilities of central and state pollution control according to water act 1974.
4. Discuss the definitions proposed by wildlife protection act 1972.
5. Discuss the provision of penalties given in Forest Act 1980.
6. What is Biomedical waste (Management & Handling) rules?
7. Discuss the Batteries (Management & Handling) rules 2001?
8. How Biological Diversity act works?
9. Elaborate merchant shipping act.
10. Discuss the Factory Act 1987.

**TRUE/FALSE**

1. Air (Prevention & control) amendment act was proposed in 1987.
2. Factories Act & amendment act was proposed in 1982.
3. Forest (conservation) act & rules 1980.
4. Indian forest act and amendments were proposed 1997.
5. Batteries rule were declared in 2006.
6. Acts and amendments are extended to whole India except J&K.
7. Sanctuary are declared under section 25(A)5.

8. Government property is referred in section 43.
9. Appointment of Director of Wildlife preservation is specified under subsection 2 of Sec 5.
10. National Park are specified under Sec 49.

### **FILL IN THE BLANKS**

1. Red Data Book deals with \_\_\_\_\_.
2. Ultraviolet radiation in the stratosphere are absorbed by \_\_\_\_\_.
3. Year 2010 has been declared as \_\_\_\_\_ year.
4. India started biosphere reserve project in \_\_\_\_\_.
5. First National Park of India is \_\_\_\_\_.
6. MABP stands for \_\_\_\_\_.
7. The area reserved for the welfare of wild life is \_\_\_\_\_.
8. \_\_\_\_ is not the greenhouse gas.
9. National Wildlife Protection Act was proposed in \_\_\_\_\_.
10. First Ozone hole was found over \_\_\_\_\_.

## CHAPTER

# 13

## Role of NGO's in Environmental Protection

The past five decades have witnessed the difficult problems encountered in providing health care services to our poor people, the majority of who live in more than half-a- million villages and in the proliferating slums of our cities. Charitable and voluntary organizations since time immemorial have been contributing significantly towards the health care of the community.

With the passage of time, Non-Governmental Organizations (NGOs) have equipped themselves adequately and come up enthusiastically in providing services like relief to the blind, the disabled and disadvantaged and helping the government in mother and child health care, including family planning programmes. As a result, all concerned have realized the potential of NGOs and their considerable merit compared to the public/private health sectors because of their staff's motivation, dedication and sympathy for the deprived sections of our society and their personalized approach towards the solution of problems.

The National Population Policy (NPP) 2000 and National Health Policy (NHP) 2002, states that there should be greater involvement of NGOs in the implementation of different health and family welfare programmes in the country. In recognition of the crucial role played by them, Government of India started granting financial aids to NGOs for various schemes. The important role played by the various national and regional level NGOs is briefly documented in the 'Encyclopedia of Social Work in India – 1968', where special mention has been made of such organizations like All India Blind Relief Society, Family Planning Association of India (FPAI), Indian Medical Association, Indian Red Cross Society, National Society for the Prevention of Blindness, Saint Parmanand Blind Relief Mission, T.B. Association of India, Bombay Mothers and Children Welfare Society; to name a few. Greater roles for the NGOs was seen to ensure Health for All through the primary health care approach. Their role was also considered as most crucial to translate the concept of 'People's Health in People's Hands' into action.

### Objectives of NGO's

1. To describe and discuss the common characteristics of health system functioning in the given socio-economic, socio-cultural, political and ecological settings
2. To highlight and delineate crucial factors responsible for the health sector reforms and to undertake, as the most challenging endeavour, effective and efficient health management and quality health care service provisions in the community
3. The fundamental objective is to act as a catalyst in bringing about local initiative and community participation in overall improvement in quality of life.

### Activities Undertaken by NGO's

**Solid waste management :** This includes both municipal solid waste and bio-medical wastes. Civic Exnoras play a major role in assisting the Municipal Corporation in the collection of garbage from individual households and the deposition of the same in secondary collection points by appointing street beautifiers in the concerned areas. With its experience over the years, Exnoras has realized that this was merely a relocation of waste rather than management of solid wastes.

**Zero waste management :** NGO's have now started focusing its efforts on the concept of Zero Waste Management, by which practically all wastes can be converted into wealth through recycling. Exnora is also addressing the problem of handling and disposal of bio- medical wastes, and is trying to find a solution beneficial to all concerned.

**Student Environment Programme (STEP) :** This program has a dual role - of creating environmental awareness amongst the student community and to develop each child's mind resources through various personality development programs. A teachers' manual and an activity book that have been brought out as a part of this program are designed in the 'do-and learn' format and provide an easy understanding of the problems faced by us and at the same time kindles the mind to find remedial measures.

**Tree Planting :** The Civic Exnoras in the city have been instrumental in planting trees for the purpose of beautification of roads, parks, playgrounds, burial grounds, etc., with the larger perspective of environmental protection.

**Vegetable Roof Gardening :** With agricultural land shrinking rapidly and deforestation rates rocketing, urban agriculture is the need of the hour. Exnora has been propagating and training youth in setting up and maintaining vegetable roof gardens in households of Tamil Nadu. The organisation is closely working with the Tamil Nadu Horticulture and Agriculture Departments on this project.

**Rain Harvesting :** NGO's have propagated the system of rain harvesting in several residential areas in the city with the aim of exploiting one or another important water source, viz., and rainwater. Many cities suffer from perennial water problems every summer and therefore it is important that all avenues of water source be tapped. By using simple and inexpensive techniques the NGO (Exnora) has arrived at a method to conserve a large part of the 110 cms of rain that we receive annually. A Water Conservation Committee constituted in Chennai by Metro Water Supply and Sewerage Board Exnora is a core member.

**AIDS Awareness :** NGOs are working diligently to educate the public about the prevention of AIDS and provide support and counseling for HIV- infected persons. The additional dangers of placing value judgments on how individuals became HIV-positive is one of the toughest issues facing NGOs that work with people who are HIV positive. One key in the prevention of AIDS is to eliminate negative images of HIV-infected persons as projected by the media. NGOs should work toward educating the public to respect the dignity of all persons living with HIV, regardless of how they became infected.

**Pollution Control :** The task of pollution control in India is complex due to the large number of heavy, large and small-scale industries involved. Further, the rise in the number of vehicles coupled with poverty and the large population puts tremendous pollution pressure on air, water and land. A comprehensive approach to pollution control is being undertaken based on the following principles:

1. Prevent pollution at source.
2. Encourage, develop and apply the best available practicable technical solution
3. Ensure that polluter pays for pollution and control arrangements.
4. Focus on protection of heavily polluted areas and river stretches.
5. Involve the NGO's in educating the public about pollution control measures to be taken.

**Noise Pollution :** Noise pollution has become a major problem in the metropolitan cities and in other urban areas. With a view to regulate and control noise producing and generating sources, the Ministry of Environment and Forests has notified the *Noise Pollution (Regulation and Control) Rules, 2000* under the Environment (Protection) Act 1986, for prevention and control of noise pollution in the country.

**Air Pollution :** The sources of Air Pollution are industries like thermal power plants, sugar mills, distilleries, paper mills etc. Vehicular emissions are another source of air pollution. The Environment (Protection) Act, 1986 has classified the industries as red, orange and green depending on the degree of pollution caused by them. It further specifies the various pollution control measures to be adopted by these industries.

**Water Pollution :** The rivers of India are part of its cultural heritage. Over the years, the quality of the water has deteriorated due to the uncontrolled release of effluents by industries into the rivers. A **National River Conservation Plan** (NRCP), which includes second phase of GAP also, has been formulated which aims to control the pollution of grossly polluted rivers of the country. A National River Conservation Authority has been setup to review the implementation of the programmes related to cleaning of rivers. The NRCP covers 141 towns located along 22 interstate rivers in 14 states. The total cost of the scheme is Rs.2013 crores. A **National Lake Conservation Plan** envisaging the conservation of lakes by prevention of pollution by catchments area treatment, desalting, weed control, based on the integrated water shed development approach, is under implementation.

**NGO's Role in Pollution Control :** The success of India's environmental programmes depends greatly on the awareness and consciousness of the people. A National Environmental Awareness Campaign has been launched to sensitise people to the environmental problems through audio -visual programmes, seminars, symposia, training programmes etc. **Paryavaran Vahinis** have been constituted in 184 districts involving the local people to play an active role in preventing poaching, deforestation and environmental pollution. **4000 NGOs** have been given financial assistance for creating environmental awareness. An **Environmental Information System (ENVIS) network** has been setup to disseminate information on environmental issues. India has a large network of NGO's, which are involved in spreading the message of sustainable development to the public.

**Institutions Involved in Environmental Activities :** An integrated effort is required in environmental planning management and action. Interdisciplinary understanding, cooperation and coordination and increased public participation and support are important components in the process towards sustainable development. To move towards Sustainable Development, DANIDA has prepared a project document for establishing "Environmental Training Institute" in Tamil Nadu. A side letter was signed between Government of India, Ministry of Finance and the Kingdom of Denmark with a Danish grant of DKR 9.961 million. Government of Tamil Nadu has also given concurrence for setting up the Environmental Training Institute in Tamil Nadu with DANIDA assistance.

**Limitations in the Performance of NGO's :** In another case, the CBI found that out of seven NGOs receiving funds to help women in self-employment, four had not done a thing and the rest existed only on paper. About 400 such NGOs have been black listed by the Council for the Advancement of People's Action and Rural Technology (CAPART) while the Central Social and Welfare Board (CSWB) has black listed 3,000 NGOs for their poor performance in different fields in our country.

**Environmental Education and Importance :** Environmental Education is a process of recognizing values and clarifying concepts in order to develop skills and added tools necessary to understand and appreciate the inter-relationship among man, his culture and his bio-physical surrounding. It creates an overall perspective, which acknowledges the fact that natural environment and man-made environment are interdependent. It should consider the environment in its totality and should be a continuous lifelong process beginning at the pre-school level and continuing through all stages. It should be inter-disciplinary and examine major environmental issues from local, national and international points of view. It should utilise various educational approaches to teach and learn about and from the environment with stress on practical activities and first-hand experience. It is through this process of education that people can be sensitized about the environmental issues.

To achieve the above objectives, the Ministry has been implementing several schemes and programmes.

**Objectives**

- Development of educational/teaching materials and aids in the formal education sector;
- To encourage non-governmental organisations, mass media and other concerned organisations for promoting awareness among the people at all levels;
- To promote environment education through existing educational/scientific/research institutions;
- To ensure training and manpower development in environment education; and
- To mobilise people's awareness for the preservation and conservation of environment.

The programmes conducted/initiatives launched as part of this scheme are categorised under Formal and Non-Formal sectors. Programmes under Formal Environmental Education are:-

1. Environment Education in School System
2. Environmental Appreciation Courses
3. Environmental concepts in Management and Business Studies

Programmes under Non-Formal Environmental Education are :

- National Environment Awareness Campaign (NEAC)
- Eco-clubs (NGC)
- Mass Awareness

**Formal Environmental Education**

Though formal education is the mandate of the Ministry of Human Resource Development (MHRD), the Ministry of Environment & Forests has been interacting with the MHRD, NCERT, State Departments of Education etc. to ensure that environmental components are adequately covered at the school levels by infusion into the school curricula at various levels. The major initiatives taken by the Ministry in this direction recently are mentioned below :

**Environment Education in School System**

Under this project, which was initiated in 1999, an exercise to strengthen environment education in the formal school curriculum has been undertaken. Based on the findings of the study, the textbooks in Science, Social Science and Languages of middle school level in eight States (100 schools in each State) are being modified to strengthen the infusion of environmental concepts. The modified textbooks would be used for one academic session (2002-2003) in the selected schools of the selected States on pilot basis. The concerned teachers of the selected schools would also be trained to effectively teach the modified textbooks. The States participating in this project are Andhra Pradesh,



Assam, Goa, Jammu & Kashmir, Maharashtra, Orissa, Punjab and Uttaranchal. Depending upon the success of the pilot implementation, the revised curriculum may be taken up in the remaining schools.

### **Environmental Appreciation Course**

Though there are several courses on environmental sciences at present in the formal system, there are no structured courses available outside the formal system for people who desire to learn about environmental issues. The Ministry has taken an initiative in this regard and it presently working out a frame work for environmental appreciation courses in consultation with IGNOU.

### **Non-formal Environment Education and Awareness**

Environmental Education, Awareness and Training plays a significant role in encouraging and enhancing people's participation in activities aimed at conservation, protection and management of the environment, essential for achieving sustainable development. The Ministry, therefore, accords priority for the promotion of non-formal environment education and creation of awareness among all sections of the society through diverse activities using traditional and modern media of communication.

Some of the major activities undertaken in this regard are as follows :

#### **National Environment Awareness Campaign (NEAC)**

The NEAC was launched in mid 1986 with the objective of creating environmental awareness at the national level. It is a multi-media campaign which utilises conventional and non-conventional methods of communication for disseminating environmental messages to a wide range of target groups. Under this campaign, nominal financial assistance is provided to registered NGOs, schools, colleges, universities, research institutions, women and youth organisations, army units, State Government Departments etc. from all over the country for organising/conducting awareness raising activities.

#### **Eco-clubs (National Green Corps)**

The main objectives of this programme are to educate children about their immediate environment and impart knowledge about the eco-systems, their inter-dependence and their need for survival, through visits and demonstrations and to mobilise youngsters by instilling in them the spirit of scientific inquiry into environmental problems and involving them in the efforts of environmental preservation.

#### **Global Learning and Observations to Benefit the Environment (GLOBE)**

The GLOBE is an International Science and Education Programme, which stress on hands-on participatory approach. India joined this programme during the August, 2000. This programme, which unites students, teachers and scientists all over the world, is aimed at school children. The students of GLOBE schools are required to collect data

about various basic environmental parameters under the supervision of a GLOBE trained teacher and use it for explaining hypothesis as well as to enhance their scientific understanding of the earth. This data is also used by the scientists in their research work. The GLOBE also provides an opportunity to the students to interact not only with the GLOBE scientists but also with the students from GLOBE schools in other parts of the world.

### **Other Awareness Programs**

The Ministry also sponsors various programs which do not fit into straitjacketed programs like NEAC, NGC, etc., and are aimed at creating environmental awareness among children. These include environment quiz (both written as well as televised), organization of activities for observation of special occasions such as earth day, special programs for children, etc. These proposals which are received throughout the year from various NGOs and other agencies, are considered on merit as and when received and are supported. Few examples such programs are:

- Awareness activities /events by NGOs, on the occasion of special Environment days like Earth Day etc.
- Written environmental quiz programs.
- Organization of an annual Vacation Program on Environmental Resources.
- Vacation program on Natural resources- building a broader constituency of support for conservation.

### **Women Education and Importance**

The Indian government has expressed a strong commitment towards education for all, however, India still has one of the lowest female literacy rates in Asia. In 1991, less than 40 percent of the 330 million women aged 7 and over were literate, which means today there are over 200 million illiterate women in India. This low level of literacy not only has a negative impact on women's lives but also on their families' lives and on their country's economic development.

Numerous studies show that illiterate women have high levels of fertility and mortality, poor nutritional status, low earning potential, and little autonomy within the household. A woman's lack of education also has a negative impact on the health and well being of her children. For instance, a recent survey in India found that infant mortality was inversely related to mother's educational level.

Additionally, the lack of an educated population can be an impediment to the country's economic development.

### **Literacy Levels Improving Over Time**

Although literacy levels are low, there has been progress in improving educational attainment for both sexes in India over the last several decades. In 1971, only 22 percent

of women and 46 percent of men were literate (Register General and Census Commissioner (RGCC), 1977). By 1991, 39 percent of women and 64 percent of men were literate (RGCC, 1993). Thus, there has been a large increase in the proportion of women who are literate in just 20 years. Despite the improvements in literacy, there continues to be a large gap between the literacy levels of men and of women. For India as a whole, the gender gap in literacy has been decreasing since 1981; in some states, however the disparity in literacy between the sexes has been growing. There are dramatic differences in literacy rates by place of residence, with rates in rural areas lagging behind rates in urban areas. In 1991, the urban female literacy rate was more than twice that of the rural rate, 64 and 31 percent, respectively (RGCC, 1993). While there have, however, been substantial increases in literacy rates in both urban and rural areas, the gap between the two sectors has not narrowed appreciably.

### **Large Differences in Literacy among the States**

The differences in literacy rates among the states are also extreme. Kerala has the highest female literacy rate, with over 86 percent of women literate in 1991. The state with the second highest female literacy is Mizoram, where nearly 79 percent of women are literate. On the other hand, there are several states that have literacy rates of less than 30 percent, including Bihar and Uttar Pradesh, the two most populous states. Together these two states have over 63 million illiterate women. These literacy levels are highly correlated with the health status of the population. Kerala has the lowest infant mortality rates and the highest life expectancies of all the states. Conversely, Uttar Pradesh and Bihar have some of the lowest life expectancies found in India (India Registrar General (IRG), 1996; IRG 1995). As with India as a whole, many states have large rural-urban differences in female literacy. In 6 of the 24 states, 25 percent or less of the women in rural areas are literate. In Rajasthan, less than 12 percent of rural women are literate.

### **Three Out of Five Girls Attend School Versus Three Out of Four Boys**

Although literacy rates in India are low, there has been a concerted effort to encourage girls to attend school, which should lead to higher literacy rates in the future. In 1992-93, 75 percent of boys and 61 percent of girls aged 6 to 10 years were attending school. As with literacy measures, there are large differences in school attendance by state. In six states, over 85 percent of girls aged 6 to 14 were attending school. Not surprisingly, these states also had female literacy rates that were above the national average. In all states except Bihar, Rajasthan, and Uttar Pradesh, more than half of the girls aged 6 to 14 were attending school. Although Bihar has the lowest enrollment for both boys and girls, there was still a large gender gap, with only 38 percent of the girls attending school compared to 64 percent of the boys (International Institute for Population Science (IIPS), 1995).

### **Beyond Literacy**

Although there are numerous studies demonstrating a link between education and a variety of demographic indicators (i.e., fertility, infant and child mortality and morbidity), more recent studies are finding that there is a minimum threshold of education (more than 5 or 6 years) that must be achieved before there are significant improvements in female autonomy<sup>3</sup>, particularly in a highly gender-stratified society such as India (Jeffery and Basu, 1996; Jejeebhoy, 1995). Of the literate women in India, 59 percent have only a primary education or less. This level of education may not be sufficient to meaningfully improve the status of these women. Only 41 percent of the literate population, or 13 percent of all Indian women, have more than a primary education.

### **Gender Gaps in University Education**

Currently, a very small proportion of both men and women have a college education, just over 3 percent of men and 1 percent of women. Although a very small proportion of the Indian population attends college, women account for a third of the students at this level (Ministry of Human Resource Development (MHRD), 1993). This sex ratio is found for most fields of study except:

1. Engineering and commerce, where women account for a much smaller proportion of the students; and
2. Education, where women account for nearly half of all students.

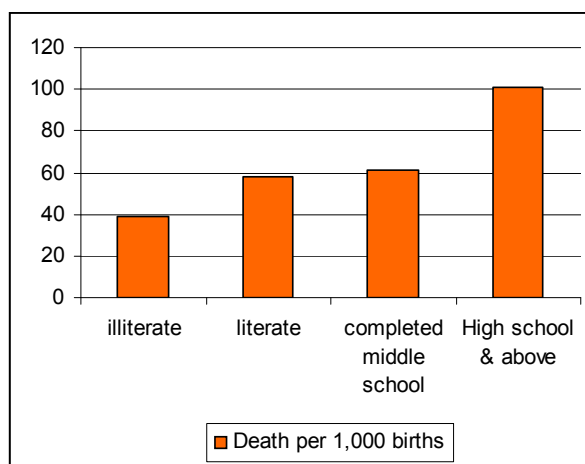
### **Alternative Education**

The Non-formal Education (NFE) program was created by the Indian Government in 1979-80 to reach **Women of the World** children that were not in the formal education system, particularly girls and working children. Classes are held at times that are convenient for the students, and the curriculum is adapted to their needs. The teacher is a local person who has been trained to run the NFE center and the classes are held either in the teacher's home or after hours in already-existing schools. In 1994, there were 255,000 centers serving 6.4 million children. Approximately 40 percent of the centers are exclusively for girls (The World Bank, 1997). While the NFE program has the potential to solve many of the problems with access to education, as with any type of education program, the quality varies from location to location (Rugh, 1994).

### **Barriers to Education**

There are several reasons for the low levels of literacy in India, not the least of which is the high level of poverty. Over one-third of the population is estimated to be living below the poverty line (The World Bank, 1997). Although school attendance is free, the costs of books, uniforms, and transportation to school can be too much for poor families. Poor families are also more likely to keep girls at home to care for younger siblings or to work in family enterprises. If a family has to choose between educating a son or a daughter because of financial restrictions, typically the son will be chosen. Negative parental

attitudes toward educating daughters can also be a barrier to a girl's education. Many parents view educating sons as an investment because the sons will be responsible for caring for aging parents. On the other hand, parents may see the education of daughters a waste of money because daughters will eventually live with their husbands' families, and the parents will not benefit directly from their education. Also, daughters with higher levels of education will likely have higher dowry expenses as they will want a comparably educated husband. However, education sometimes lowers the dowry for a girl because it is viewed as an asset by the husband's family.



**Fig. 13.1. Infant Mortality Rates, by Mother's Educational level**

### **Inadequate School Facilities**

Another barrier to education in India is the lack of adequate school facilities. Many states simply do not have enough classrooms to accommodate all of the school-age children. Furthermore, the classrooms that are available often lack basic necessities such as sanitary facilities or water. In Uttar Pradesh, a recent survey found that 54 percent of schools did not have a water supply and 80 percent did not have latrines (The World Bank, 1997b). Lack of latrines can be particularly detrimental to girls' school attendance. In some states, the inadequate supply of classrooms is further compounded by the large increase in the number of school-age children due to high population growth rates. For instance, in 1993, Uttar Pradesh needed to build 284,000 additional classrooms to achieve full enrollment of children age 6 to 10 (The World Bank, 1997b). The need for new classrooms will persist as the population continues to grow. On the other hand, in states where population growth rates are low (e.g., Kerala), the number of primary-age children is beginning to decline and state governments can focus on improving the quality of education rather than increasing the supply of classrooms.

**Conclusion**

Non-Governmental Organizations (NGOs) have equipped themselves adequately and come up enthusiastically in providing services like relief to the blind, the disabled and disadvantaged and helping the government in mother and child health care, including family planning programmes. As a result, all concerned have realized the potential of NGOs and their considerable merit compared to the public/private health sectors because of their staff's motivation, dedication and sympathy for the deprived sections of our society and their personalized approach towards the solution of problems.

**LONG ANSWER**

1. How NGO's can play an important role in Environmental education?
2. What is the role of National River Conservation plan (NRCP)?
3. How many institutions are involved in environmental activities?
4. What are the limitations of NGO's performances?
5. How the NGO's can be make more effective?
6. Discuss various programs under formal environmental education.
7. Why the women education is important?
8. Discuss the barriers of education system.
9. Discuss the current situation of schools in India.
10. How the credibility of NGO's can be decide?

**SHORT ANSWER**

1. Discuss the objectives of NGO's?
2. What do you know about "STEP"?
3. Why the AIDS awareness is must?
4. What are the roles of NGO's in pollution control?
5. How the NGO's can play crucial role in environmental education.
6. What types of activities are undertaken by NGO's?
7. How the infant mortality rate is related to mother's educational level?
8. Discuss the role of parents in child education?
9. How social practices effect the education system?
10. Discuss various awareness programs running currently for education.

**TRUE/FALSE**

1. National Population Policy (NPP) was introduced in \_\_\_\_\_.
2. FPAI stands for \_\_\_\_\_.

3. \_\_\_\_\_ NGO's have been given financial assistance for environmental awareness.
4. NEAC stands for \_\_\_\_\_.
5. In 1971, only \_\_\_\_\_ % of women were literate.
6. \_\_\_\_\_ state has the highest female literacy rate.
7. Uttar Pradesh state has \_\_\_\_\_ % of literacy rate.
8. NFE program was created by government in year \_\_\_\_\_.
9. \_\_\_\_\_ state has the lowest infant mortality rate.
10. Today over \_\_\_\_\_ million women are illiterate in India.

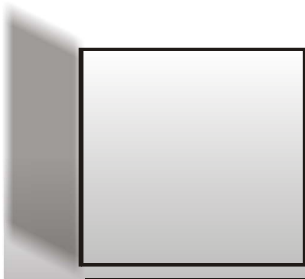
### FILL IN THE BLANK

1. National Health Policy (NHP) was introduced in 2006.
2. In 1991, literacy rate of women was 29%.
3. Kerala has 28% of women literacy rate.
4. In Rajasthan 79% of women are literate.
5. IIPS stands for International Institute of People Science.
6. World's environment day is celebrated on 5<sup>th</sup> June.
7. Headquarters of environment education is at Ahmedabad.
8. Red panda is the logo of WWF-N.
9. The main focus of environmental education is to maintain economic stability.
10. Eco-clubs are concern with automobiles.

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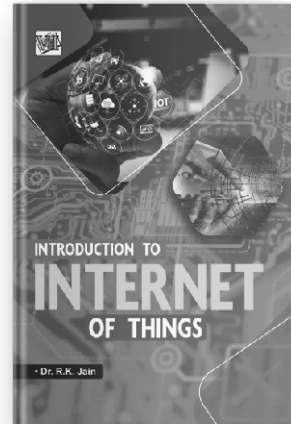
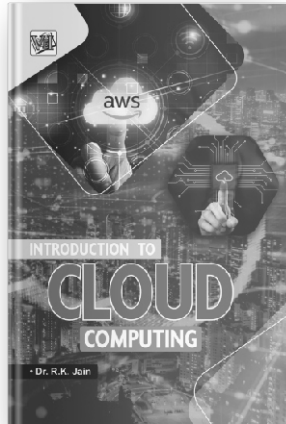
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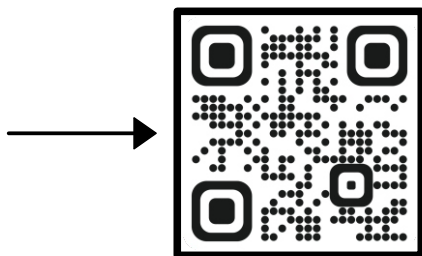
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