B.A./B.Com./BBA/BCA PART-II

SEMESTER-III

ENVIRONMENTAL AND ROAD SAFETY AWARENESS

Department of Distance Education

Punjabi University, Patiala

Lesson Nos. :

UNIT-A

Note:- The students can download syllabus from departmental website **www.pbidde.org**

Lesson No. 1.1 **Writer: Mrs. Amita Kaistha**

The Multidisciplinary Nature of Environmental Studies

Structure:

1.1.0 Objectives

After going through this lesson, students will be able to:

1. Understand and define environment.
2. Define environmental education.
3. Analyse the characteristics of environmental education.
4. Explain the need of environmental education for every one.

1.1.1 Introduction

With the rapid development and advancement environmental education has become a new source of concern for educators, teachers, students, administrators, as well as planners. It is an integral part of the education. It makes the students aware of various environmental problems. It not only brings out and discusses various causes of environmental problems but also suggests the means to solve the problems. It develops positive attitude and eco-friendly habits among students. Everything which the living organisms have to interact on this earth constitutes the environment. With the development of technology man felt a new confidence in his abilities, not merely in having a high standard of living but in overpowering any obstacle whatsoever. The destruction of nature by man results in harm to his own existence. It is necessary for his survival that man should have harmony with his environment. He should try to save his environment.

1.1.2 Concept of Environment

Etymologically environment means, 'Surroundings'. It is the sum total of external factors, influencing development or growth of people, animals, or plants, living or non-living, working conditions etc. This raises three questions in our mind. First is what is surrounded? By what surrounded? And where surrounded? Answers to these questions are in general living objects and particularly man is surrounded by physical environment in his habitat or space. "Environment refers to the sum total of conditions which surround man at a given point in space and time". Our immediate concern is the quality of space we live in, the air we breathe, the food we eat, the water we drink and the resources we draw from the environment to support our economy.

Environment is not a single subject. It is an integration of several subjects that include both science and social studies. To understand all the different aspects of our environment we need to understand biology, chemistry, physics, geography resource management, economics and population issues. Thus, the scope of

environmental studies is extremely wide and covers some aspects of nearly every major discipline.

1.1.2.1 Definitions of Environment

Different persons define environment in their own ways:

(i) According to Anastasi, "The environment is everything that affects the individual except his genes".

(ii) In the views of P. Crisbert, "Environment is anything immediately surrounds an object and exerting a direct influence on it.

(iii) M.J. Herkovitts, "Environment is the aggregate of external forces which effect the life and development of living organisms".

Different people define environment with different angles but it may be safely argued that environment is a inseparable whole and is constituted by the interacting systems of physical, biological and cultural elements which are inter-related individually' as well as collectively in various ways.

1.1.2.2 Characteristics of Environment

By analyzing the above mentioned definitions of environment we can summarize the following characteristics of environment:

1) The sum total of all the stimulations from birth until death.
2) It is everything which affects the individual excluding their genes.
3) All the external forces which affect the growth and development of living organisms.
4) It consists of physical, intellectual, social, moral, cultural, emotional, economic and political forces, which affect the life and nature of behaviour.
5) It refers to sum total of conditions which surround man at given point in space and time.
6) It has land, air and water, as its physical components and plants, animals including man and his several functions, organizations and institutions as biological components.
7) It involves, physical, chemical, biological, social, economical, political and cultural processes.

1.1.2.3 Types of Environment

Kurt Lewin has enumerated three types of environment which influence the personality of an individual:

1. Physical Environment
2. Social and Cultural Environment
3. Psychological Environment

1. Physical Environment : It refers to geographical climate and weather or physical conditions in which an individual lives. The human race is greatly influenced by the climate. Even heredity is influenced by the physical environment. The individual tries to adjust in his physical environment.

2. Social and Cultural Environment : It refers to the social, economic and political conditions of an individual in which he lives. The moral, cultural and emotional forces affect the life and nature of individual behaviour. School and classroom climate should be open type so as to develop the potentialities of the student.

3. Psychological Environment : Kurt Lewin has laid emphasis on the psychological environment of an individual. He has used the term 'life space' for explaining psychological environment. The person and his goal forms the psychological environment.

1.1.2.4 Structure and Components of Environment

On the basis of basic structure the environment may be divided into two basic types:

(1) Physical or abiotic environment

(2) Biological or biotic environment

(1) Physical or abiotic environment: It includes solid earth (lithosphere), liquid or water (hydrosphere) and the gases (atmosphere).

(2) Biological or biotic environment : It consists of plants (flora) and animals (fauna) including man as a prime factor.

Mainly environment has two components –physical and biological. But the

components of environment can be classified in the following categories:

1. Physical components are land, water and air.
2. Biological components are plants and animals.
3. Social components are population, social system, social changes, urbanization etc.
4. Cultural components include –morale and values of religion, political, economic ethics.
5. Psychological components are self concept, lie-space, level of aspiration, topology and goals of life.
6. Energy components include solar and geothermal energy.

1.1.3 Meaning and Definition of Environmental Education

Environmental education is the new area of study of the discipline of education. It is an integral part of the education. Every organism has its own environment. Man's environment consists of natural as well as socio-cultural environment. Education can change & improve the quality of man's environment for desirable modification of his behavior.

Education deals with various problems and principles which govern the relationships between students and their environment which is created by school and teacher formally and informally. The educational process of development occurs in physical, social, cultural and psychological environment.

Environmental education is education through, about and for environment.

1. **About :** means understanding of total environment.
2. **From:** means gathering concepts, knowledge and skills related to specific academic discipline.
3. **For :** means the development of attitude, skills and evaluation abilities for the proper use of environment and development of environment.

According to the Environmental Education Act, 1970, "Environmental Education is the educational process which deals with man's relationship with his natural and man-made surrounding and includes the relation of population, pollution, resources, allocation and depletion conservation, transportation, technology and urban and rural planning to the total human environment in the United States Public Law 91-516".

Sharma, RA. (1996) said, "Environmental education refers to the awareness of physical and natural environment and perceive its relevance for real life situation. The problems and issues are to be identified. The imbalances of environment are to be improved in view of sustainable development."

Cook and Hearn (1971), "Environmental education is problem centred, interdisciplinary, value oriented, community-oriented and concerns with man's survival as species based on student initiated activities and involvements present and future oriented."

The **Finnish National Commission** in a seminar held in 1974 has said, "Environmental education is a way of implementing the goals of environmental protection. Environmental education is not a separate branch of science or subject of study, it should be carried out according to the principle of lifelong integral education."

In so far as the teaching for environment is concerned, it means controlling the environment, establishing proper ecological equilibrium which entails proper use and conservation of resources and also involves control of environmental pollution. It also includes proper environmental planning so that environment is not only functionally useful but is also aesthetically enjoyable. This aspect would include horticultural planning, rural planning and urban planning.

This definition of environmental education appears on first reaction to be simplistic and superficial but actually it is comprehensive and deep for it denotes that environmental education is a medium and process of education that it covers man's relationship with his natural as well as social and manmade environment, and also it includes the relationship of population, industrialization, pollution, resource allocation and depletion, conservation, transportation, technology, energy and urban and rural planning to the total biosphere.

1.1.4 Need of Environmental Education

When human beings discovered agriculture and gained a relative abundance of food, they stopped wandering and settled into villages that gradually became cities. With the beginning of civilization, technology, surplus food and relative security, human grew in numbers and influence and began to alter the environment more rapidly than nature could repair it. Although, we now have sufficient scientific and technological knowledge to solve many environmental

problems, it is impossible to make wise decisions about the environment without an understanding of economics, anthropology, political science, sociology, history and the humanities as well as the natural and physical sciences.

The concept and term "Environmental education" is very new but it has very ancient roots in our culture. In Rigveda (our ancient scripture) it has been stated that "The dust (Dhuli) of mother earth and light of father sky should be associated with full brightness for our welfare". According to Rigveda, there are three kinds of god–the celestial, the aerial and terrestrial i.e. water, air and land.

In present situation man and environment are considered interrelated and there is interdependence in them. The environment becomes a source of sorrow and unhappiness, because the dust of earth, light and air of sky have adverse effect on human beings. Therefore, we need "Environmental Education".

In our country the study of environmental education is more essential. The diverse geographical features of India make it prone to a variety of disasters ranging from earthquakes to Tsunamis. This compels the young generation of India to comprehend the need of living in harmony with nature.

The country has accepted the need for environmental education with the recommendations of the Tiwari Committee (1980). Besides introducing the subject of 'Environmental Science' at all levels of education, we must give much emphasis on the new approaches and programmes of environmental education, thus the idea is to bring environmental concern in all subjects.

Most people recognize the urgent need for environmental education, but only some have clear ideas about what needs to be done and very few have either the actual experience or the knowledge about the courses that need to be taught. The chief objective of environmental education is that individual and social groups should acquire awareness and knowledge, develop attitudes, skills and abilities and participate in solving real-life Environmental problems. The respective should be integrated, inter-disciplinary and holistic in character.

Environmental education is indeed very important for child and adult for self-fulfilment and social development. People start viewing local flora and fauna and the problems associated with them. It helps in the maintenance of life and health in self-preservation and in the preservation of human race. It helps to understand different food chains and ecological balance in nature. It helps to

understand and appreciate how environment is used for making a living and for promoting material culture and helps in enjoying nature and society. It directs attention towards the problem' of population explosion, exhaustion of natural resources, pollution and sheds light on the methods of solving these problems.

The lay public in rural, tribal, slum and urban areas, women and students and teachers in schools, colleges, and universities as well as planners and decision and policy makers, programme implementators and workers need to be educated about the environment.

The area of 'environment education' is very wide as compared with the environmental science. It can be illustrated with the help of the following statements;

"If you want to grow a crop, you have a plan for a year". It is the job of agriculture scientists. "If you want to grow a plant you have to plan for ten years". It is the task of plant scientists. "If you want to grow/educate a man, you have to plan for hundreds of years". It is the responsibility of an educationist.

The agriculture and plant scientists are also educated and trained for their area of study. In fact education is considered as the highest order investment which becomes an asset in time to come.

Indeed disciplines such as Physics, chemistry, zoology, Botany, Geography, History, Economics etc. should all be the means to promote the immediate and future welfare of mankind.

Environmental education makes students understand the concept of sustainable development which is the need of today. This subject makes students realize that this is man who depends on nature not vice-versa. This subject develops the skill of observation and analysis in the students. Government is taking several steps but is not successful everywhere. Participation of people is, therefore, utmost importance in planning and management of the environment.

It provides that the teaching done in schools is not related to life and environment. This explains the need answers the 'Why' of the curriculum of environmental education.

1.1.5 Scope of Environmental Education

1. It is a process of recognizing the interrelation among man, his cultural and biological surroundings.

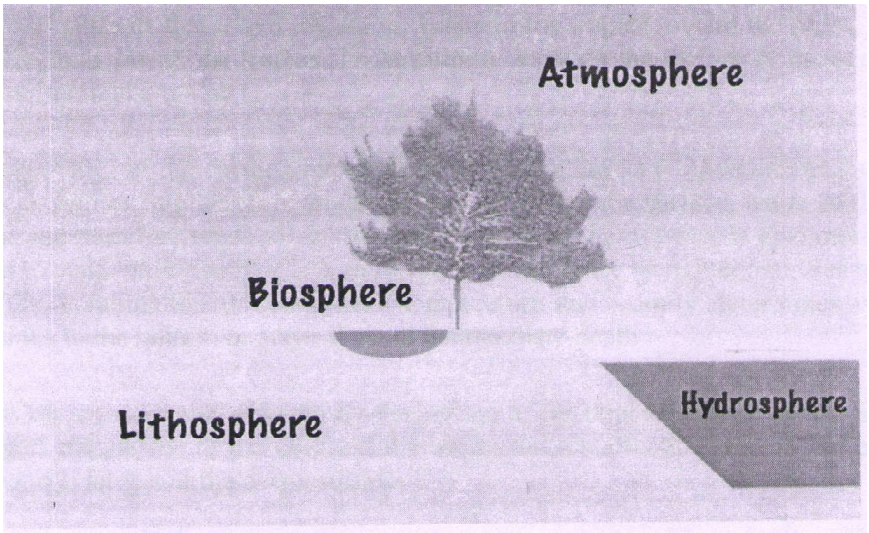
2. It appears to be a process that equips human beings with awareness, skills, attitudes, values and commitments to improve environment.
3. It refers to the knowledge and understanding of physical, biological, cultural and psychological environment and to perceive its relevance for real life situation.
4. It involves the knowledge of proper utilization of natural resources for mankind.
5. It identifies the imbalance of environment and tries to improve it in view of sustainable development.
6. It entails practice in decision making and self-formulations of a code of behaviour about problems and issues concerning environmental quality.
7. It involves child's investigation and systematic exploration of his own natural and social environment and prepares himself to solve problems or improving his life.
8. It is problem-centred, interdisciplinary, value and community oriented and concerns with man's survival and development. It concerns with the present and future.
9. It provides the basis for construction and creative skills for the practice of healthy living and improvement.
10. It involves both theoretical and practical aspect of environment to improve the imbalances and prevent the deterioration by pollutions.
11. It utilizes educational approaches methods and techniques of teaching to identify the real causes of environmental problems- and practice problem solving skills in formal and non--formal situations.

1.1.6 Concept of Biosphere

The biosphere is simply "life on Earth" – the sum total, that is, of all living things on Earth. It has derived it name from greek word "bios" means life and "sphaira" means sphere. Life is everywhere - in the oceans, beneath the soil, and even inside your body. In 1875, geologist Eduard Suess was the first scientist to use the term **biosphere** to describe the part of the earth where life exists. The earth is divided into 'spheres':

* The **lithosphere** consists of the earth's crust and upper part of its mantle.

* The **atmosphere** is what we call 'the air', or the mixture of gases held around the earth by its gravitational pull.
* The **hydrosphere** is the sum total of all of earth's water in any form, whether it's on the ground as liquid or ice, or in the clouds as water vapor.



All of these spheres interact with one another through many different means such as the water cycle and biogeochemical cycles like the carbon and nitrogen cycles.

The biosphere is the fourth sphere, and consists of the places where life can be found. Since life exists in the air, on and in the earth, and on and in water, the biosphere overlaps, connects, and influences all of the other sphere - and they all affect the biosphere. The biosphere is composed of all living organisms. Plants, animals, and one-celled organisms are all part of the biosphere. Most of the planet's life is found from three meters below the ground to thirty meters above it and in the top 200 meters of the oceans and seas. Considering the sheer number of organisms on earth, however, the biosphere is actually fairly small in size. Most of the biosphere's life is found between 500 meters below the surface of the ocean and six kilometers above the surface of the earth, although there are organisms, especially microorganisms, able to live at much higher and lower depths. The biosphere

is quite old, its creation coincides with the appearance of the first bacteria, about 3.5 billion years ago. As life has changed and become more complex, so has the biosphere.

Lithosphere : It is rigid, rocky outer layer of the Earth, consisting of the crust and the solid outermost layer of the upper mantle. It extends to a depth of about 60 miles (100 km). It is broken into about a dozen separate, rigid blocks, or plates. Slow convection currents deep within the mantle, generated by radioactive heating of the interior, are believed to cause the lateral movements of the plates (and the continents that rest on top of them) at a rate of several inches per year.

Hydrosphere : is the liquid water component of the Earth. It includes the oceans, seas, lakes, ponds, rivers and streams. The hydrosphere covers about 70% of the surface of the Earth and is the home for many plants and animals.

The hydrosphere, like the atmosphere, is always in motion. The motion of rivers and streams can be easily seen, while the motion of the water within lakes and ponds is less obvious. Some of the motion of the oceans and seas can be easily seen while the large scale motions that move water great distances such as between the tropics and poles or between continents are more difficult to see. These types of motions are in the form of currents that move the warm waters in the tropics toward the poles, and colder water from the Polar Regions toward the tropics. These currents exist on the surface of the ocean and at great depths in the ocean (up to about 4km).

The characteristics of the ocean which affects its motion are its temperature and salinity. Warm water is less dense or lighter and therefore tends to move up toward the surface, while colder water is more dense or heavier and therefore tends to sink toward the bottom. Salty water is also more dense or heavier and thus tends to sink, while fresh or less salty water is less dense or lighter and thus tends to rise towards the surface. The combination of the water's temperature and salinity determines whether it rises to the surface, sinks to the bottom or stays at some intermediate depth.

The oceans currents are also affected by the motion of the atmosphere, or winds, above it. The energy in the wind gets transferred to the ocean at the ocean surface affecting the motion of the water there. The effect of wind is largest at the ocean surface.

The ocean serves two main purposes in the climate system. First, it is a large reservoir of chemicals that can contribute to the greenhouse effect in the atmosphere and energy absorbing 90% of the solar radiation which hits the surface. This reservoir changes very slowly limiting how fast the climate can change. Second, it works with the atmosphere to redistribute the energy received from the sun such that the heat in the topics, where a lot of energy is received from the sun, is transferred toward the poles, where heat is generally lost to space.

The hydrosphere includes the oceans, rivers, lakes, and even the moisture in the air. Ninety-seven percent of the earth's water is in the oceans. The remaining three percent is fresh water; three-quarters of the fresh water is solid and exists in ice sheets.

Atmosphere : The atmosphere is the body of air which surrounds our planet. Most of our atmosphere is located close to the earth's surface where it is most dense. The air of our planet is 79% nitrogen and just under 21% oxygen; the small amount remaining is composed of carbon dioxide and other gasses.

All four spheres can be often present in a single location. For example, a piece of soil will of course have mineral material from the lithosphere. Additionally, there will be elements of the hydrosphere present as moisture within the soil, the biosphere as insects and plants, and even the atmosphere as pockets of air between soil particles.

The Earth's atmosphere is a thin layer of gases that surrounds the Earth. It composed of 78% nitrogen, 21% oxygen, 0.9% argon, 0.03% carbon dioxide, and trace amounts of other gases. This thin gaseous layer insulates the Earth from extreme temperatures; it keeps heat inside the atmosphere and it also blocks the Earth from much of the Sun's incoming ultraviolet radiation.

The Earth's atmosphere is about 300 miles (480 km) thick, but most of the atmosphere (about 80%) is within 10 miles (16 km) of the surface of the Earth. There is no exact place where the atmosphere ends; it just gets thinner and thinner, until it merges with outer space.

1.1.7 Summary

We have discussed various basic concepts which are necessary to understand the concept of environment and environmental education. Environment is the

sum total of external factors, substances and conditions which influences organism. Kurt Lewis has enumerated three types of environment, (i) Physical, (ii) Social, and (iii) Psychological environment. Environmental education is education through environment, about environment and for environment.

This is indeed very important for child and adult for self fulfillment and social development. It helps to understand and appreciate how environment is used for making a living and for promoting material culture and helps in enjoying nature and society.

1.1.8 Glossary

1.	Environment	:	sum total of external influences affecting an organism.
2.	Environmental Education	:	Education that equips human beings with awareness, knowledge, skills, attitude and commitment to improve environment.
3.	Nature	:	The whole universe and every creation or force(s) controlling the phenomena of the physical world.

1.1.9 Suggested Readings and Web Sources

1.	Environmental education	-	By R.A. Sharma
2.	Environmental education	-	By R.C. Sharma
3.	Education for values, environment and human rights	-	By B.L. Sharma & B.K. Maheshwari
4.	Modern Teaching of Environmental education	-	By S.M. Zaidi

Web Sources:

1.	en.wikipedia.org	2.	greenteacher.org
3.	enfor.nic.in	4.	India.gov.in

1.1.10 Suggested Questions

Q.1. Define environment. Discuss in detail the characteristics and components of environment.

Q.2. Define the term 'Environmental Education' and discuss its scope.

Q.3. Discuss the main features and need of Environmental education.

Q.4. Discuss the concept of Biosphere.

Q.5. Why there is need for Public Awarness. Discuss. And Suggests ways to create awareness among the public.

Q.6. Define Biosphere, Lithosphere and hydrosphere.

1.1.11 Self Check Exercise

Fill in the Blanks:

1. Etymological meaning of environment is ..... .
2. Physical components of environment includes ....., ... and ..... .
3. Environmental education was recommended by ..... In school curriculum in India.
4. The main two components of environment are ..... and ..... .
5. Environmental education is indeed very important for ..... and ..... for self fulfillment and social development.

Ans: 1. Surroundings. 2. Land, water, air. 3. Kothari. 4. biotic, abiotic. 5. Child, adult.

Lesson No. 1.2 Author: Dr. Shailinder Sekhon

Natural Resources and Associated Problems-I
(Forest and Land Resources)

Structure of the Lesson:

1.2.0 OBJECTIVE

The main objective of this lesson is to introduce the students with the concept

and management of resources which are (i) Forests, (ii) Minerals; and (iii) Land. The attempt has also been made to highlight the associated problems of other natural resources in the part of the lesson.

1.2.1 INTRODUCTION

About ten thousand years ago, when mankind changed from hunter-gatherers, living in wilderness areas such as forests and grasslands, into agriculturalists, we began to change the environment to suit our own requirements. Man plays important roles in the natural environment system in different capacities such as biological or physical man, social man, economic man and technological man.

The role of most primitive biological or physical man in the functions of natural environmental system was fundamentally as user of environmental resources and thus he played the role of a factor of the environment but as the skill and technology of man developed with cultural development, his roles towards natural environment also changed progressively such as from user through modifier and changer to destroyer of the environment.

1.2.2 NATURAL RESOURCES

The environment and resources are of most concern to the present society and also for future generations. There are various types of resources-social resources, physical resources, natural resources, human resources etc. The natural resources in the form of matter and energy are of vital significance for the successful survival of all types of life on the planet earth in general and for human being in particular. In fact, all aspects of human society (social, cultural, political and economic) depend on resources.

Ecosystems act as resource producers and processors. Solar energy is the main driving force of ecological systems, providing energy for the growth of plants in forests, grasslands and aquatic ecosystems. A forest recycles its plant material slowly by continuously returning its dead material, leaves, branches etc. to the soil. Grasslands recycle material much faster than forests, as the grass dries up after the rains are over every year. All the aquatic ecosystems also depend on solar energy and have cycles of growth when plant life spreads and aquatic animals breed; the sun also drives the water cycle.

Our food comes from both natural and agricultural ecosystems. Traditional agricultural ecosystems depended on rainfall have been modified in recent times

to produce more and more food by the addition of extra chemicals and water. Moreover, modern agricultural system creates a variety of problems, which ultimately lead to the formation of unproductive land. To manufacture consumer products, industries require raw materials from nature, including water, minerals and power. During the manufacturing process, the gases, chemical and waste products pollute our environment, unless the industries are carefully managed to clean up their wastes and effluents.

1.2.3 FOREST RESOURCES

The term forest can be defined in many ways. **Ecologically,** it signifies a complex system composed of distinct biological units called 'Forest Communities' comprising trees and other woody species with a fairly closed canopy.

Literally, forest is, therefore, a large uncultivated tract of land covered with trees and under wood.

Officially, forest is any area set aside for timber, climate and for other protective purposes.

Forests are the most dwindling resources throughout the world. Food, fodder, fuel, fibre, tools, shelter, timber, non-wood products apart from protection of environment are all provide by forests. Forest also serve as home to diverse plants and animals besides serving as a sink to polluting gases and maintaining the balance of carbon dioxide and oxygen in environment. Following are the various functions performed by the forest resources:

1.2.3.1 Functions of Forest Resources: Following are the various functions performed by the forest resources:

1. **Watershed Protection:** Forests
   - (a) reducing the rate of surface run-off of water;
   - (b) preventing flash floods and soil erosion; and
   - (c) producing prolonged gradual run-off and thus safeguarding against Drought.

2. **Erosion Control:**

Forests holding soil by preventing rain from directly washing soil away.

3. **Land Bank:**

Forests maintaining soil nutrients and structure.

4. Atmosphere Regulation: Forests

(a) do absorption of solar heat during evapotranspiration,

(b) maintain carbon dioxide levels for plant growth; and

(c) maintain the local climate conditions.

5. Use of Local People:

Under mentioned are some areas of consumption of forest produce by local people who collect it for:

(a) Food: gathering plants, fishing, hunting from the forest.

(b) Fodder for cattle.

(c) Fuelwood and charcoal for cooking and heating.

(d) Poles for building homes especially in rural and wilderness areas.

(e) Timber for household articles and construction.

(f) Fibre for weaving baskets, ropes, nets, string etc.

(g) Sericulture for silk.

(h) Apiculture or rearing bees for honey.

(i) Medicinal plants for traditional medicines etc.

6. Market Use (Productive Use):

Following are some market uses of forest resources:

(a) Most of the above discussed products used for consumptive purposes are also sold as a source of income for supporting the livelihoods for forest-dwelling people.

(b) Minor forest produce like fuel, wood, fruit, gum, fibre etc. can be sold in local markets.

(c) Major timber extraction for construction, industrial uses, paper pulp etc. is a source of income for forest dwellers.

1.2.3.2 Forest Resources and Associated Problems:

Following are the problems associated with forest resources :

(i) India's serious environmental problem is forest degradation due to timber extraction and our dependence on fuelwood.

(ii) Forest resources are limited and it is not feasible to plant enough trees at a sufficient rate to support the need for timber and fuelwood.

(iii) Over-utilization of forests as a source of revenue from timber. Deforestation became a major concern in British times when a large amount of timber was extracted for building their ships. Another period of over-utilization and forest degradation occurred in the early period following Independence as people felt after the British had gone they had a right to use our forests in any way. But if timber is over-harvested, the ecological functions of the forests are lost.

1.2.3.3 Use and over exploitation of Forest Resources

In India, forests form 23 percent of the total land area. The word 'forest' is derived from the Latin word 'forts' means 'outside' A forest is a large area of land covered with trees or other woody vegetation.

A forest is a natural, self-sustaining community characterized by vertical structure created by presence of trees. Trees are large, generally single-stemmed, woody plants. Forest can exist in many different regions under a wide range of conditions, but all true forests share these physical characteristics.

Therefore, the present status of any forest, indeed of any natural community, reflects what has gone on before.

Use and Over Exploitation :

A forest is a biotic community predominantly of trees, shrubs and other woody vegetation, usually with a closed canopy. This invaluable renewable natural resource is beneficial to man in many ways.

The direct benefits from forests are :

(a) **Fuel Wood :** Wood is used as a source of energy for cooking purpose and for keeping warm.

(b) **Timber :** Wood is used for making furniture, tool-handles, railway sleepers, matches, ploughs, bridges, boats etc.

(c) **Bamboos :** These are used for matting, flooring, baskets, ropes, rafts, cots etc.

(d) **Food :** Fruits, leaves, roots and tubers of plants and meat of forest animals form the food of forest tribes.

(e) **Shelter :** Mosses, ferns, insects, birds, reptiles, mammals and micro-organisms are provided shelter by forests.

(f) **Paper :** Wood and Bamboo pulp are used for manufacturing paper (Newsprint, stationery, packing paper, sanitary paper)

(g) **Rayon :** Bamboo and wood are used in the manufacture of rayon (yarns, artificial silk-fibres)

(h) **Forest Products :** Tannins, gums, drugs, spices, insecticides, waxes, honey, horns, musk, ivory, hides etc. are all provided by the flora and fauna of forests.

The indirect benefits from forests are :

(a) **Conservation of Soil :** Forest prevent soil erosion by binding the soil with the network of roots of the different plants and reduce the velocity of wind and rain - which are the chief agents causing erosion.

(b) **Soil-improvement :** The fertility of the soil increases due to the humus which is formed by the decay of forest litter.

(c) **Reduction of Atmospheric Pollution :** By using up carbon dioxide and giving off oxygen during the process of photosynthesis, forests reduce pollution and purify the environment.

(d) **Control of Climate :** Transpiration of plants increases the atmospheric humidity which affects rainfall and cools the atmosphere.

(e) **Control of Water flow :** In the forests, the thick layer of humus acts like a big sponge and soaks rain water preventing run-off, thereby preventing flash-floods. Humus prevents quick evaporation of water, thereby ensuring a perennial supply of water to streams, springs and wells.

Over exploitation of forests has led to loss of natural habitat, ecosystem and their bio diversity.

Human are indisputably a part of most forests. With the exception of extremely inaccessible forestilands, all forests present on Earth today have been influenced by human being for tens of thousands of years. In many cases, forest communities have never been without the influence of human activities.

Because of the widespread nature of human activity in forests, it is tempting to think of human endeavor as one more outside factor influencing forest development. This approach is misleading, however, since it denies the role of self-awareness in human activity. Because human beings can understand cause and effect, and because we have amassed an increasingly deep body of knowledge about forest processes over the past ten millennia, human influences simply cannot be likened to the blind forces of nature.

Since pre-history, human beings have realized benefits from forested lands in the form of spiritual values, medicines, shelter, food, materials, fuel and more. Often, humans have sought to manipulate natural processes so as to compel forest systems to produce more of the goods and services desired by people.

Examples range from culturally modified trees and edge habitat maintained by the Haida and others in west-coastal North America to Pre-Colombian enrichment planting of Brazil nut trees in the Amazon to traditional coppice management in the English lowlands.

At times, human management has become as intensive as to become the primary set of factors under which the forest system operates. Such systems move towards the near total human control found in agricultural systems and cannot be thought of as forests in any natural sense, although they may continue to resemble forests superficially.

1.2.3.4 Deforestation & its impact

Deforestation is the permanent destruction of indigenous forests and woodlands. The term does not include the removal of industrial forests such as plantations of gums or pines. Deforestation has resulted in the reduction of indigenous forests to four-fifths of their pre-agricultural area.

Indigenous forests now cover 21% of the earth's land surface. The World Resources Institute regards deforestation as one of the world's most pressing land-use problems. The difference between forests and woodlands is that whereas in a forest the crowns of individual trees touch to form a single canopy, in woodland, trees STOW far apart, so that the canopy is open.

Of great concern is the rate at which deforestation is occurring. Currently, 12 million hectares of forests are cleared annually. Almost all of this deforestation occurs in the moist forests and open woodlands of the tropics.

At this rate all moist tropical forest could be lost by the year 2050, except for isolated areas in-Amazonia, the Zaire basin, as well as a few protected areas within reserves and parks. Some countries such as Ivory Coast, Nigeria, Costa Rica, and Sri Lanka are likely to lose all their tropical forests by the year 2010 if no conservation steps are taken.

The destruction of forests due to unscrupulous and indiscriminate felling of trees has lead to an overall deterioration of our environment and is posing a serious threat to the quality of "life in future". Forest area in world has dwindled from 7,000 million hectares (year 1900) to 2S90 million hectares (year 1975).

***Causes of Deforestation* :**

(1) Population Explosion :

Population explosion poses a grave threat to the environment. Vast areas of forest land are cleared to trees to reclaim land for human settlements (factories, agriculture, housing, roads, railway tracks etc.) growth of population increases the demand for forest products like timber, firewood, paper and other valuable products of industrial importance, all necessitating felling of trees.

(2) Forest Fires :

Fires in the forest may be due to natural calamities or human activities :

(a) Smoldering of the humus and organic matter forming a thick cover over the forest floor (i.e. ground fires)

(b) Dried twigs and leaves may catch fire (i.e. surface fires).

(c) In densely populated forests, tree tops may catch fire by heat produced by constant rubbing against each other (i.e. crown fires).

(d) Human activities like clearing forest for habitation, agriculture, firewood, construction of roads, railway tracks and carelessness (throwing burning cigarette stubbs on dried foliage).

Fire destroys fully grown trees, results in killing and scorching of the seeds, humus, ground flora and animal life.

(3) Grazing Animals :

Trampling of the forest soil in the course of overgrazing by livestock has four

reaching effects such as loss of porosity of soil, soil erosion and desertification of the previously fertile forest area.

(4) Pest Attack :

Forest pests like insects etc. destroy trees by eating up the leaves, boring into shoots and by spreading diseases.

(5) Natural Forces :

Floods, storms, snow, lightening etc. are the natural forces which damage forests.

Effects of Deforestation :

Forests are closely related with climatic change, biological diversity, wild animals, crops, medicinal plants etc.

Large scale deforestation has many far-reaching consequences :

(a) Habitat destruction of wild animals (animals are deprived of food and shelter.)

(b) Increased soil erosion due to reduction of vegetation cover.

(c) Reduction in the oxygen liberated by plants through photosynthesis.

(d) Increase in pollution due to burning of wood and due to reduction in carbon-dioxide fixation by plants.

(e) Decrease in availability of forest products.

(f) Loss of cultural diversity.

(g) Loss of Biodiversity.

(h) Scarcity of fuel wood and deterioration in economy and quality of life of people residing near forests.

(i) Lowering of the water table due to more run-off and thereby increased use of the underground water increases the frequency of droughts.

(j) Rise in Carbon dioxide level has resulted in increased thermal level of earth which in turn results in melting of ice caps and glaciers and consequent flooding of coastal areas.

1.2.3.5 Self Check Exercise : I

Ques. 1. Define the term 'Atmosphere Regulation' with forest resources.

1.2.4 LAND RESOURCES

Land itself is a most important resource; it is necessary for food production, animal husbandry, industry and for our growing human settlement. These forms of intensive landuse are frequently extended at the cost of 'wild lands': our remaining forests, grasslands, wetlands, and deserts. So, it is essential to evolve a rational land use policy that examines how much land must be made available for different purposes and where it must be situated.

To produce million tonnes of food grains we will depend upon the health of soils.

1.2.4.1 Concept of Soil :

Soil is a complex mixture of organic materials like clay, silt, pebbles and sand; decaying organic matter and billions of living organisms mixed together in such a way as to have capillary and non-capillary pore spaces filled with moisture and air. Formation of soil is a very slow process that occurs due to the interaction of physical, chemical and biological activities on the surface of rocks.

As land is a static resource of nature it cannot be increased. And on the other side growing population pressure as well as energy intensive life style (such as, rapid urbanization and industrialization) are a threat to land area considerably. Following are other associated problems of using land resources.

1.2.4.2 Land Resources and Associated Problems:

The land can be considered a renewable resource by utilizing carefully. But if forests are depleted, or grasslands overgrazed, the land becomes unproductive and wasteland is formed. Land is also converted into a non-renewable resource when highly-toxic industrial and nuclear wastes are dumped on it. Problems associated with land resources are as discussed below:

1. Land Degradation:

Every year 5-7 mHa of land worldwide is added to the existing degraded farmland. Over-irrigating farmland leads to salinization, as the evaporation of water brings the salts to the surface of the soil on which crops cannot grow. The use of more and more chemical fertilizers poisons the soil and eventually the land becomes unproductive.

2. Soil Erosion:

The loss of top fertile surface layer of the soil is called soil erosion.

There may be natural or geological erosion or human-accelerated erosion. The misuse of an ecosystem leads to the loss of valuable soil through erosion by the moonsoon rains and, to a smaller extent, by wind. The roots of the trees in the forest hold the soil. Thus, deforestation leads to rapid soil erosion.

3. Soil Pollution:

Soil pollution usually results from the disposal of solid and semi-sold wastes from agricultural practices, industries and urban waste. Fallout from atmospheric pollution also contributes to soil pollution. The major soil polluting agencies are: (i) Industrial and Urban Wastes, (ii) Faulty Agricultural Practices, (iii) Radioactive Materials; and (iv) Biological Agents.

This is a serious loss and will have unfavourable long-term effects on human civilizations.

1.2.4.3 Self Check Exercise-III

Ques. 3 What is Soil Erosion ?

1.2.5 SUMMARY

Our environment provides us with a variety of goods and services necessary for our day-to-day lives, but the land, forests, water and minerals that we derive from nature, are in themselves not distributed evenly throughout the world or within countries. Secondly, environment does not recognise political boundaries. Like in the medium of air, there is no wall or boundary or compartment in the media of water or land. Therefore, any act of gross environmental degradation at one place in a country is bound to have its adverse effect on the neighbouring areas. So, if a resource gets exhausted at one place its impact will have to be borne by each and every individual directly or indirectly. Hence, the management of the available resources as discussed in this lesson are major environmental issues of immediate global concern.

1.2.6 Glossary

1. **Renewal** Resources : those can be used again and again.
2. **Non-renewal** Resources : those can be used once.
3. **Abiotic:** It constitutes the physical or non-living components like air and water.

4. **Biotic:** Biotic components are the living organisms that get influenced or influence the surroundings.
5. **Afforestation:** It means creation of new forest.
6. **Defforestation:** Destruction of forests.
7. **Reforestation:** Sustain the forest resource.
8. **Acid Rain:** Rainfall with acids in it.

1.2.7 ANSWERS TO SELF CHECK QUESTIONS

Exercise-I

Ans. to Ques. No. 1 : Atmosphere Regulation: Forests

(i) absorb the solar heat

(ii) maintain carbon dioxide levels for plants growth and

(iii) maintain local climatic conditions, which is known as atomspheric regulation.

Exercise-II

Ans. to Ques. No. 2: Mineral Resources:

The mineral resources are naturally-occurring substance of definite chemical composition and identifiable physical properties. These resources are formed over a period of millions of years in the Earth's crust. After that, minerals and ores need to be extracted from the earth's interior so that they can be used and this process is known as mining.

Exercise-III

Ans. to Ques. No. 3: Soil Erosion:

The loss of top fertile surface layer of the soil is called soil erosion. It may be:

(i) Natural Erosion or Geological Erosion; or

(ii) Human-accelerated Erosion

1.2.8 EXERCISE

(a) Short Questions:

Ques. 1. Define the term Eco-system.

Ques. 2. What do you mean by Watershed Protection ?

Ques. 3. Write a short note on formation of mineral.

(b) Long Questions:

Ques. 1.Illustrate the term Deforestation and describe the functions performed by the forest resources.

Ques. 2.Write a detailed note on the formation of minerals and associated problems of them.

Ques. 3.What do you mean by land resources ? Explain the sources of land/soil pollution.

1.2.9 SUGGESTED READINGS

1. Text Book of Environmental Studies by Erach Bharucha, University Grants Commission, (Universities Press).
2. Environmental Education (Principles, Concepts and Management) by K. K. Shrivastava, Kanishka Publishers, New Delhi.
3. An Elementary Book on Environmental Education by J. S. Yadava, R. C. Sobti, R. K. Kohli, Publication Bureau, Panjab University, Chandigarh.
4. Biology and Water Pollution Control by C.E. Warren

Lesson No. 1.3 Author: Dr. Shailinder Sekhon

NATURAL RESOURCES AND ASSOCIATED PROBLEMS-II

(Water and Energy Resources)

Structure of the Lesson:

1.3.7 Answers to Self Check Questions

1.3.8 Exercise

1.3.9 Suggested Readings

1.3.0 OBJECTIVE

The main objective of this lesson is to introduce the students with the concept and management of natural resources that are (i) Water; (ii) Food; and (iii) Energy

The attempt also has been made to highlight the problems associated with these natural resources.

1.3.1 INTRODUCTION

Our dependence on nature is so great that we cannot continue to live without protecting the earth's environmental resources, however, mankind has been overusing and depleting natural resources. The over-intensive use of land has exhausted the capability of the ecosystem to support the growing demands of more and more people, all requiring intensive use of resources. The need for more water, more food, more energy, more consumer goods, is not only the result of a greater population, but also the result of over-utilization of resources by people from more affluent societies, and the affluent sections of our own. Rural as well as urban centres cannot exist without resources such as water from rivers and lakes, food from agricultural areas, domestic animals from pasture lands and timber, fuelwood, construction materials and other resources from forests. Rural agricultural systems are dependent on forests, wetlands, grasslands, rivers and lakes.

The resulting movement of natural resources from the wilderness ecosystems and agricultural sector to the urban user has led to a serious inequality in the distribution of resources among human beings, which is both unfair and unsustainable.

1.3.2 RENEWABLE AND NON-RENEWABLE RESOURCES

The resources are fundamental base for the economic growth and development of human society but their withdrawal from the nature, mode of their uses by human beings and their disposal have enormous adverse effect on the environment.

The very fundamental principle of resources is that resources even renewable,

are finite. For example, air, water are in abundance and are very much renewable but when they are polluted and degraded, they become unusable and non-renewable because it becomes very difficult to restore the original quality of air and water if they have been degraded beyond a certain critical limit.

Generally, we can divide all the resources into two categories, that are: (i) Renewable resources and non-renewable resources.

1. Renewable Resources:

Although water and biological living resources are considered renewable, they are infact, renewable only within certain limits. Renewable resources are linked to natural cycles, such as the water cycle.

2. Non-Renewable Resources:

Non-Renewable resources have been formed in the lithosphere over millions of years and constitute a closed system. It include fossil fuels such as oil and coal, which if extracted at the present rate, will soon be totally used up. The end product of fossil fuels are in the form of heat and mechanical energy and chemical compounds, which can't be reconstituted as a resource.

Such resources, once used, remain on earth in a different form and unless recycled properly, become waste material.

1.3.3 WATER RESOURCES

Water is the most important element in the biosphere because on one hand it is vital for the maintenance of all forms of life and on the other hand it helps in the movement, circulation and cycling of nutrients in the biosphere. Water is also essential for power generation, navigation, irrigation of crops, disposal of sewage etc. Increased demand of water consequent upon increasing population and industrial expansion has degraded the quality of water considerably.

Though water like other natural substances has self purifying capacity during recycling processes but when the amount of foreign undesirable substances added by the man to the water exceeds the tolerance level and self purifying capacity of water, it gets polluted.

1.3.3.1 Water Pollution:

Water pollution may be defined as alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

Thus refers:

(i) deteriorate physical, chemical and biological quality of water;

(ii) Causes the harmful effects on man, animals and vegetations and also quality of environment;

(iii) Due to natural (like land slides, volcanic eruptions, dust, soil erosion) and human activities (like industry, agriculture, urbanization, radioactive mining etc.), and

(iv) deteriorate quality of environment.

It is also defined as 'alternation in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

Sources of Water Pollutants:

In brief there are two main sources of water pollution as follows:

(i) Natural Sources:

These sources of water pollutants includes soil erosion, volcanic eruption, land slides, coastal and cliff erosion, floods, decomposition of plants and animals.

(ii) Man-Induced Sources:

These sources of water pollutants include industrial development, urbanization, agricultural sources, cultural sources like religious fairs and pilgrimage.

1.3.3.2 Water Sources and Associated Problems:

The nature and intensity of water pollution is linked with many factors like :

(i) Waste water disposal and treatment system;

(ii) Hydrological conditions of diluting bodies;

(iii) Self-purification capacity of streams;

(iv) Characteristics of effluents discharging from an area;

(v) Social-economic conditions of the communities generating the wastes; and

(vi) Type of soil and vegetation.

The water sources and their associated problems can be divided on different basis as discussed below:

(A) Problems associated with sources of Pollutants:

Water gets polluted by various pollutants which may be divided into:

(i) Industrial Pollutant: These pollutants mean industrial waste water, including chemical pollutants such as chlorides, sulphides, carbonates, ammonical, nitrogen, nitrites, heavy metals such as mercury, lead, zinc, arsenic, barium etc.

(ii) Agricultural Pollutants: It includes chemical fertilizers, pesticides, insecticides and herbicides and several other synthetic chemical compounds, weed and plant remains.

(iii) Urban Pollutants: The urban pollutants are of various types of ion such as sulphate ion, nitrate ion, chlorine ion and sodium ion etc.

(iv) Natural Pollutants: Other natural pollutants are volcanic dusts, sediments due to weathering and erosion, debries caused by landslides and decayed.

(B) Problems Associated with Physical and Chemical Properties:

On the basis of physical and chemical properties problems associated with water pollutants are divided into following categories:

(i) Physical Pollutants: It means pollutants affect colour and taste, and also includes turbidity, sediments, volcanic dust, oil and grease, dissolved and suspended solids and total solids.

(ii) Chemical Pollutants: The chemical pollutants includes chlorides, sulphides, carbonates etc. as already discussed.

(iii) Degradable and Non-degradable Pollutants: Those pollutants which are broken down and decomposed by biological means such as decomposes/microorganisms are called degradable pollutants. Non-degradable pollutants are those which cannot be degraded by biological means.

1.3.3.3 Effects of Water Pollution on Health:

Water pollution has immense health effects. These effects depend upon the type of pollutant. Water pollution from domestic and human waste water causes many severe water born diseases. Recent data shows that about 21% of all

communicable diseases in India (11.5% of all diseases) are water borne diseases.

Problems Associated with Biological Agents:

In the more developed countries of the world, sewage treatment plants and other pollutants controlling techniques have reduced or eliminated most of the worst sources of pathogens in inland surface water. Further, drinking water is also disinfected by chlorination.

But the situation in less developed countries is quite distressing. It was estimated that only 25% of the people in these countries have adequate sanitation and that less than half have access of clean drinking water.

Among the most important waterborne diseases are typhoid, cholera, bacterial and anaerobic dysentery, enteritis, polio, infections hepatitis, malaria, yellow fever and filariasis. These are transmitted by insects. Altogether, at least 25 million deaths each year are blamed on these water related diseases. Nearly 2/3rd of the mortality of children under 5 years old are associated with waterborne diseases.

Problems Associated with Chemical Agents:

Since Roman times lead poisoning has been known to be dangerous to human health. A serious source of drinking water pollution is lead pipes. Even lead soldier in pipe end joints and metal containers can be hazardous.

Many of the organic chemicals are highly toxic. Exposure to even low concentrations can cause birth defects, genetic disorders and cancer.

1.3.3.4 Uses of Surface & Ground Water

Water is the most abundant, inexhaustible resource. It covers nearly 70% of the globe in the form of oceans, rivers, lakes etc. and out of this only 3% is fresh water. There are two types of water usage of surface and ground water :

Consumptive use : where water is completely utilized and cannot be reused like for domestic, industrial and irrigation purpose.

Non-consumptive use : water is not completely utilized and is reused like hydro power plant.

Other uses of water

1. Water is used for domestic purposes like drinking, bathing, cooking, washing etc.

2. Water is used in commerical establishments like hotels, theaters, educational institutions, offices, etc.
3. Almost 60-70% of fresh water is used for irrigation.
4. 20-30% of water is used for industrial operations by refineries, iron & steel industries, paper & pulp industries, etc.
5. Water plays a key role in sculpting the earth's surface, moderating climate and diluting pollutants.

1.3.3.5 Over Utilization of Surface & Ground Water & its Impact

The rapid increase in population and industrial growth led to severe demand on water resources. After using all available surface water resources to the maximum, human beings began using groundwater to meet their needs.

1. The increased extraction of groundwater far in excess of the natural recharge led to decreased groundwater level. The erratic and inadequate rainfall caused reduction in storage of water in reservoirs. This also led to decrease of groundwater.
2. Building construction activities seal permeable soil zone and reduce the area for percolation of rainwater thereby increasing surface runoff.
3. If groundwater withdrawal rate is higher than recharge rate, sediments in aquifers get compacted resulting in sinking of overlaying land surface. This is called land subsidence which leads to structural damage in buildings, fracture in pipes and reverses the flow of canals leading to tidal flooding.
4. Over-utilization of groundwater in arid and semi-arid regions for agriculture disturbs equilibrium of reservoir in the region causing problems like lowering of water table and decreased pressure in aquifers coupled with changes in speed and direction of water flow.
5. Over utilization of groundwater in coastal areas leads to rapid intrusion of salt water from the sea thereby rendering it unusable for drinking and agriculture.
6. Over-utilization of groundwater leads to decrease in water level thereby causing earthquake, landslides and famine.

7. Over-utilization of groundwater leads to drying-up of dug wells as well as bore wells.
8. Due to excess use of groundwater near agricultural fields, agricultural water that contains nitrogen as a fertilizer percolates rapidly and pollutes the groundwater thereby rendering the water unfit for potable use by infants. (Nitrate concentration exceeding 45 mg/L).

1.3.3.6 Fertilizer-Pesticide Problem

Farming is one potential source of such contamination. Surface runoff carries manure, fertilizers, and pesticides into streams, lakes, and reservoirs, in some cases causing unacceptable levels of bacteria, nutrients, or synthetic organic compounds. Similarly, water percolating downward through farm fields carries with it dissolved chemicals, which can include nitrate fertilizers and soluble pesticides. In sufficient quantities these can contaminate groundwater supplies.

Fertilizers :

Substances which are added to the soil to increase its fertility are called fertilizers. Many natural substances like leaves, cow dung, bone meal compost etc are used to make up deficiency of nitrogen, phosphorous and potassium in soils. These nutrients are lost from agricultural fields through runoff, drainage, or attachment to eroded soil particles. The amounts lost depend on the soil type and organic matter content, the climate, slope of the land, and depth to groundwater, as well as on the amount and type of fertilizer and irrigation used.

Nitrogen is the most readily lost because of its high solubility in the nitrate form. Leaching of nitrate from agricultural fields can elevate concentrations in underlying groundwater to levels unacceptable for drinking water quality.

Phosphorus does not leach as readily as nitrate because it is more tightly bound to soil particles. However, it is carried with eroded soils into surface water bodies, where it may cause excessive growth of aquatic plants. If this process precedes far enough, lakes and reservoirs become choked with decaying mats of algae, which have offensive odors and can cause fish kills from the resulting lack of dissolved oxygen.

Potassium, the third major nutrient in fertilizers, does not cause water quality problems because it is not hazardous in drinking water and is not a limiting

nutrient for growth of aquatic plants. It is tightly held by soil particles and so can be removed from fields by erosion, but generally not by leaching.

Disadvantages of Use of Artificial Chemical Fertilizers :

The increased use of artificial inorganic fertilizers like ammonium sulphate, phosphate etc. to increase food supplies has proved detrimental for environment. Modern agricultural techniques are wasteful in the use of fertilizers. It may lead to :

1. Increase in water borne diseases due to contamination of surface and ground water resources.
2. Loss of natural fertility of the soil.
3. Loss of organic matter from the soil.
4. Threat to the quality of drinking water due to disposal of fertilizers into landfills sites and lands.

Pesticides :

The trend toward intensive crop production in modern farming has led to increased potential for damage by pests and diseases. One drawback to this is that pesticides generally kill not only the pest of concern, but also a wide range of other organisms, including beneficial insects and other pest predators. Once the effect of the pesticide wears off, the pest species is likely to recover more rapidly than its predators because of differences in the available food supply. Previously unimportant species may also become significant crop pests when their natural predators are killed by pesticide applications. Certain pesticides like DDT, BHC etc present in the environment accumulates in the blood, milk and fat of animals and beyond permitted levels they are dangerous to human beings as well as animals. Different herbicides which are used for destroying weeds can destroy the vegetation in the neighbouring areas also.

Another drawback to the increasing pesticide use of the development of resistance in pest species. The individual pests that survive pesticide applications continue to breed, gradually producing a population with greater tolerance to the chemicals applied. Pesticides, therefore, have to be used in ever increasing quantities or replaced with new chemicals to adequately control pest populations.

Disadvantages of Use of Pesticides :

Pesticides are the chemicals used to mix with the soil to kill pests. Following are its disadvantages :

1. Species which are not targeted are also killed or injured.
2. After sometime the pest develop resistance against the pesticides.
3. Soil fertility is reduced.
4. On short duration exposure it causes illness and slow poisoning to human beings.
5. On long duration exposure it causes cancer, genetic defects, immunological and other chronic diseases.

1.3.3.7 Water Logging & Salinity

"Water logging" is defined as the state of land in which the subsoil water table is located at or near the surface with the result that the yield of crops commonly grown on it is reduced well below for the land, or, if the land is not cultivated, it cannot be put to its normal use because of the high subsoil water table. The practicle of irrigation results in consumptive uses of water through evapo transpiration, leaving behind higher salt concentrated in a smaller volume of water. In irrigated agricultural land, water logging is often accompanied by soil salinity as waterlogged soils prevent leaching of the salts imported by the irrigation water.

Salts are a major water quality factor in choosing disposal options for subsurface drainage in arid irrigated areas. "Salinity" can restrict the urban or agricultural re-use of drainage water, as it is the most significant long-term water quality concern for managing irrigated agriculture in arid zones. Salinity has not been noted as a serious concern with subsurface drainage waters from humid areas. This is generally due to the higher rainfall, higher dilution capacity in surface waters and lower initial salt content in the soil. Drainage of irrigated land is required to reduce water logging and soil salinization that inevitably accompanies water logging in arid zones. At present, about 20-30 million hectares of irrigated land is seriously affected by salinity.

Harmful effects of water logging and salinity :

Harmful effects of water logging and salinity are caused by unthoughtful planning

of irrigation system. With respect to water logging and salinity, there are following harmful effects :

1. Waterlogged soil provides excellent breeding grounds for mosquitoes, and cause malaria.
2. It causes loss in crop yield.
3. When waterlogged soil is fully saturated, plant roots cannot absorb water. Therefore, they are deprived of aeration. Due to absence of aeration, anaerobic conditions exist killing the aerobic bacteria present in the root-zone of the plant. This aerobic bacterium helps to make food for the plant. These aerobic bacteria transform chemical compounds into nitrogen and phosphorus and provide food to the plant. Due to water logging, killing of these bacteria occurred and ultimately causes the death of the plant.
4. In rainfall or irrigation, water after saturating the root-zone travels downward washing down excess salts. When the unsaturated conditions begin, plant start taking up water. In waterlogged soil, water moves upwards due to capillary. It brings up salts more and more in the root-zone. Thus making soil solution excessively saline. The plant then faces hindrances in taking up moisture. This results in permanent wilting of the plant.
5. Where land is totally waterlogged, salinity causes destruction of vegetation and crops. Water logging causes desposition of salts in the root zone. If the salts are alkaline, then soil pH increases. If the soil pH increases of 8.5, it affects the plant and if increases to 11.0 then plant becomes infertile. If the salts are acidic, then it's lower the pH. For acidic salts with pH low than 4, plants cannot adsorb nutrients and die.
6. Destruction of roads occurred due to reduced bearing capacity of waterlogged soil.
7. Rise of water through capillary in the buildings, causes dampness and therefore causes diseases. This also causes peeling off plasters and appearance of salt patched on the walls of the buildings.
8. Certain weeds grow very fast in the waterlogged area and normal

crops cannot compete with them. Thus suppressing the useful crops to grow.

9. Due to reduced bearing capacity, agricultural machinery cannot operate well in the fields.

10. Saline soil being unfit for agriculture is used for making bricks. The salts from these bricks appear on the surface whenever they get dry.

1.3.3.8 Self Check Exercise-I

Ques. 1. What do you mean by Water Pollutants?

1.3.4 ENERGY RESOURCES

The Sun is the primary energy source in our lives. We use it directly for its warmth and through various natural processes that provide us with food, water, fuel and shelter. The sun's rays power the growth of plants which form our food material, give off oxygen which we breathe in and take up carbon dioxide that we breathe out. The sun's energy evaporates water from oceans, rivers and lakes to form clouds that turn into rain.

We use energy for household use, agriculture, production of industrial goods and for running transport. Modern agriculture uses chemical fertilizers, which require large amounts of energy during their manufacture. The industry uses energy to power manufacturing units and the urban complexes that support it.

1.3.4.1 Types of Energy: Energy has always been closely linked to man's economic growth and development. The present strategies for development focused on rapid economic growth, have used energy utilization as an index of economic development. This index, however, does not take into account the adverse long-term effects of excessive energy utilization on society. Generally there are three types of energy:

(i) non-renewable energy

(ii) renewable energy

(iii) and nuclear energy which uses such small quantities of raw material (uranium) that supplies are, to all effect limitless. But this classification is inaccurate because several of the renewable sources, if not used 'sustainably', can be depleted more quickly than they can be renewed.

Following are various types of energies classified on the basis of renewal and non-renewal sources:

(A) Non-Renewable Energy: These sources cover:

(i) Oil

(ii) Coal and

(iii) Gas etc.

(B) Renewable Energy: These systems use resources that are constantly replaced and usually less polluting. For example:

(i) Hydropower

(ii) Solar

(iii) Wind

(iv) Geothermal

(v) Biomass Energy etc.

1.3.4.2 Energy resources and associated problems:

All energy use creates heat and contributes to atmospheric temperature. In addition, many forms of energy release carbon dioxide and lead to global warming. The inability to effectively manage and safely dispose of nuclear waste is a serious global concern. Following are the other associated problems of nuclear resources.

(i) Oil and its environmental impacts: The processes of oil and natural gas drilling, processing, transport and utilization have serious environmental consequences such as, leaks in which air and water are polluted and accidental fires that may go on burning for days or weeks before they are put out.

While refining oil, solid waste like salts and grease are produced, which also damaged the environment.

(ii) Coal and its environmental impacts: Coal is the world's single largest contributor of greenhouse gases and is one of the most important causes of global warming.

Many coal-based power generation plants are not fitted with devices which are a major source of air polluter. Burning coal also produces oxides of sulphur and nitrogen which combined with water vapor lead to 'acid rain'. This kills forest, vegetation, damages architectural heritage sites, pollutes water and affects human health.

(iii) Hydroelectric Power and its environmental impacts: The long life of hydropower plants, the renewable nature of energy source, very low operating and maintenance costs, and absence of inflationary pressure are some of its advantages. Although hydroelectric power has led to economic progress around the world, it has created serious ecological problems as mentioned here:

(i) To produce hydroelectric power, large areas of forest and agricultural lands are submerged.

(ii) The silting of the reservoirs reduces the life of the hydroelectric power installations.

(iii) Need of water for domestic, agricultural and industrial purpose gives rise to conflicts over the equitable allocation of water.

(iv) The use of rivers for navigation and fisheries becomes difficult once the water is dammed to generate electricity.

(v) The opposition to many large hydroelectric schemes is growing.

(vi) In seismically sensitive regions, large dams can induce increased seismic activity, resulting in earthquakes.

(iv) Solar Energy and Environmental Impacts: In one hour, the sun pour as much energy onto the earth as we use in a whole year. So major problem is to use the available energy as much as is possible. For example for water heating, solar cookers, photovoltic energy, solar thermal electric power and other solar powered devices.

(v) Biomass Energy and Environmental Impacts: Biomass energy is a form of stored solar energy. Since the waste materials used in biomass conversion are formed in such low concentration in each region, they must be transported to the conversion facilities, creating an additional cost. Some scientists suggest cultivating plants specifically for biomass conversion, but the necessary land is not always available.

(vi) Wind Power and Environmental Impacts: Wind is an intermittent source and the intermittency of wind depends on the geographic distribution of wind. So it cannot be used as the sole resource for electricity. Wind power has few environment impacts, as there are virtually no air or water emissions, or radiation, or solid waste production. The principal problems are bird kills, noise, effect on TV reception, and aesthetic objections to the sheer number of wind turbines that are required to meet electricity needs.

(vii) Geothermal Energy and Environmental Impacts: It is the energy stored within the earth ('geo' for earth and 'thermal' for heat). Geothermal energy starts with hot, molten rock deep inside the Earth, which surfaces at some parts of the Earth's crust.

Geothermal energy is nearly as cheap as hydropower and will thus be increasingly utilized in future. However, water from geothermal reservoirs often contains minerals that are corrosive and polluting. In addition, geothermal fluids are a problem which must be treated before disposal.

1.3.4.3 Use of Alternate Energy Resources

There are many alternate energy resources which are enviornment friendly and harness natural processes. These sources of energy are not harmful for the environment as they do not deplete any resource to create energy. These are :

1. Tidal Power
2. Wave Power
3. Solar Power
4. Wind Power
5. Hydro Electricity
6. Radiant Energy
7. Geothermal power
8. Biomass
9. Compressed Natural gas
10. Nuclear Power

1. Tidal Power : Tidal energy can be generated in two ways, tidal stream

generators or by barrage generation. The power created though tidal generators is generally more environmentally friendly and causes less impact on established ecosystems. Similar to a wind turbine, many tidal stream generators rotate underwater and are driven by the swiftly moving dense water. Although not yet widely used, tidal power has potential for future electricity genration.

2. **Wave Power :** Wave power is the transport of energy by ocean surface waves, and the capture of that energy to do useful work - for example for electricity generation, water desalination, or the pumping of water (into reservoirs). Wave energy can be difficult to harness due to the unpredictablity of the ocean and wave direction. Wave farms have been created and are in use in Europe, using floating wave Energy converters.

3. **Solar Power :** Photovoltaic (PV) Solar power is harnessing the suns energy to produce electricity. One of the fastest growing energy sources, new technologies are developing at a rapid pace. Solar cells are becoming more efficient, transportable and even flexible, allowing for easy installation. PV has mainly been used to power small and medium-sized applications, from the calculator powered by a single solar cell to off-grid homes powered by a photovoltaic array.

4. **Wind Power :** Wind power is the conversion of wind energy by wind turbines into a useful form, such as electricity or mechanical energy. Large-scale wind farms are typically connected to the local power transmission network with small turbines used to provide electricity to isolated areas. Residential units are entering production and are capable of powering large appliances to entire houses depending on the size. Wind farms installed on agricultural land or grazing areas, have one of the lowest environmental impacts of all energy sources.

5. **Hydro Electricity :** Hydroelectricity is electricity generated by hydropower, i.e., the production of power through use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy. Once a hydroelectric complex is constructed, the project produces no direct waste. Small scale hydro or micro-hydro power has been an increasingly popular alternative energy source, especially in remote areas where other power sources are not viable. Smallscale hydro power systems

can be installed in small rivers or streams with little or no discernible environmental effect or disrutpion to fish migration. Most small scale hydro power systems make no use of a dam or major water diversion, but rather use water wheels to generate energy.

6. **Radiant Energy :** This natural energy can perform the same wonders as ordinary electricity at less than 1% of the cost. This natural energy form can be gathered directly from the enviornment or extracted from ordinary electricity by the method called fractionation. One of the earliest wireless telephones to the based on radiant energy was invented by Nikola Tesla. The device used transmitters and receivers whose resonances were tuned to the same frequency, allowing communication between them.

7. **Geothermal Power :** Geothermal energy is a very powerful and efficient way to extract a renewable energy from the earth through natural processes. This can be performed on a small scale toprovide heat for a residential unit (a geothermal heat pump), or on a very large scale for energy production through a geothermal power plant. It has been used for space heating and bathing since ancient roman times, but is now better known for generating electricity. Geothermal power is cost effective, reliable, and environmentally friendly, but has previously been geogrpahically limited to areas near tectonic plate boundries.

8. **Biomass :** Biomass, as a renewable energy source, refers to living and recently dead biological material that can be used as fuel or for industrial production. In this context, biomass refers to plant matter grown to generate electricity or produce for example trash such as dead trees and brancehs, yard clippings and wood chips biofuel, and it also includes plant or animal matter used for production of fibers, chemicals or heat. Biomass may also include biodegradable wastes that can be burnt as fuel. Industrial biomass can be grown from numerous types of plants, including miscanthus, switchgrass, hemp, corn, poplar, willow, sorghum, sugarcane, and a varieyt of tree species, ranging from eucalyptus to oil palm (palm oil). The particular plant used is usually not important to the end products, but it does affect the processing of the raw material. Production of biomass is a growing industry as interest in sustainable fuel sources is growing.

9. **Compressed Natural Gas :** Compressed Natural Gas (CNG) is a fossil fuel substitute for gasoline, diesel, or propane fuel. Although its combustion does produce greenhouse gases, it is a more environmentally clean alternative to those fuels, and it is much safer than other fuels in the event of a spill (natural gas is lighter than air, and disperses quickly when released). CNG is used in traditional gasoline internal combustion engine cars that have been converted into bi-fuel vehicles (gasoline/CNG). Natural gas vehicles are increasingly used in Europe and South America due to rising gasoline prices. In response to high fuel prices and environmental concerns, CNG is starting to be used also in light-duty passenger vehicles and pickup trucks, medium-duty delivery trucks, transit and school buses, and trains.

10. **Nuclear Power :** Nuclear power is any nuclear technology designed to extract usable energy from atomic nuclei via controlled nuclear reactions. The only method in use today is through nuclear fission, though other methods might one day include fusion and radioactive decay. All utility-scale reactors heat water to produce steam, which is then converted into mechanical work for the purpose of generating electricity or propulsion. www.listverse.com

1.3.4.4 Self Check Exercise-II

Ques. 2. How can Energy be conserved ?

1.3.5 SUMMARY

The irony of the situation is that water is not equitably distributed on the earth. Secondly, water contains infective and parasitic agents, unwanted chemical substances beyond a permissible limit. The problem now is to determine the level of pollution that permit economic and social development without causing health hazards. In case of food resources, unsustainable agriculture pollute our environment with excessive use of fertilizers and pesticides, but if farmers uses traditional varieties and grows several different crops, the chance of complete failure is lowered considerably. So, sustainable agriculture is required which conserves land, water and plant, and animal genetic resources, does not degrade the environment, and is economically viable and socially acceptable. As discussed in this lesson we need to remember that even a single electrical light that is burning unnecessarily is a contributor to environment degradation.

1.3.6 GLOSSARY

1.	Hydroelectric Power :	Use of water flow to turn turbines to generate electricity is know as hydroelectric power.
2.	Chemical Energy :	Energy which is present in chemical compounds and released when they broken down in the presence of oxygen.
3.	Prospecting :	Searching for minerals
4.	Exploitation :	Extracting the minerals from the mines
5.	FAO :	Food and Agricultural Organization
6.	Monoculture :	Large farms grow single crops
7.	STE :	Solar Thermal Electric Power
8.	P. V. Energy :	Photovoltaic Energy
9.	NPBD :	National Project on Biogas Development
10.	SPM :	Suspended Particular Matter

1.3.7 ANSWERS TO SELF CHECK QUESTIONS

Self Check Exercise-I

Ans. to Ques. No. 1: Water Pollutants: The water pollutants are those substances/material which pollute the water. For example : Industrial waste chemicals used in agriculture, urban pollutants etc.

Self Check Exercise-II

Ans. To Ques. No. 2: Energy Conservation: "Energy saved is the energy conserved" is a common saying. We can conserve energy by preventing or reducing energy waste and by using resources more efficiently. But people often waste because the government subsidizes it.

It is easy to waste energy but cheaper to save it than generate it, so one should take care while using it.

1.3.8 EXERCISE

(A) Short Questions:

Ques. 1. Define Water Resources.

Ques. 2. Distinguish between renewal and non-renewal energy.

(B) Long Questions:

Ques. 1. Discuss various problems associated with sources of water pollutants.

Ques. 2. Explain in detail the problems associated with Coal and Oil energy sources.

1.3.9 REFERENCES AND SUGGSTED READINGS

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Lesson No. 1.4 **Author: Dr. Sarbjeet Singh**

ROLE OF AN INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFESTYLES

"The Earth provides enough to satisfy every man's need but not every man's greed". **Mahatma Gandhi**

1.4.1 INTRODUCTION

Natural resources have been exploited by humans since the beginning of civilization or even before. Earlier, the resources were abundant in relation to human population no significant depletion occurred. But, during last few decades, human population has increased considerably causing serious damage on destruction of natural resources. This modernization has brought about rapid industrialization followed by unplanned cities which have further degraded our environment as well as over exploitation of natural resources. Therefore, an integrated approach in their planning, development and management is imperative to ameliorate poverty, unemployment and for achieving ecological balance and sustainable development.

1.4.2 MEANING OF NATURAL RESOURCE

A resource or natural resource is anything we get from physical environment to meet our needs and wants. Anything which is useful to man or can be transformed into a useful product or can be used to produce a useful thing can be referred to as a resource.

The sum of all physical, chemical, 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 natural environment-such as land, water, air, minerals, forest, rangeland, wildlife, fish or even human population- that man can utilize to promote his welfare may be regarded as a natural resource.

Ramade (1984) defined resource "*as a form of energy and /or matter which is essential for the functioning of organisms, populations and ecosystem. In the particular case of humans, a resource in his words is any form of energy or matter, essential for the fulfilment of physiological, socio-economic, and cultural needs, both at the individual level and that of community.*"

1.4.3 CLASSIFICATION OF NATURAL RESOURCES

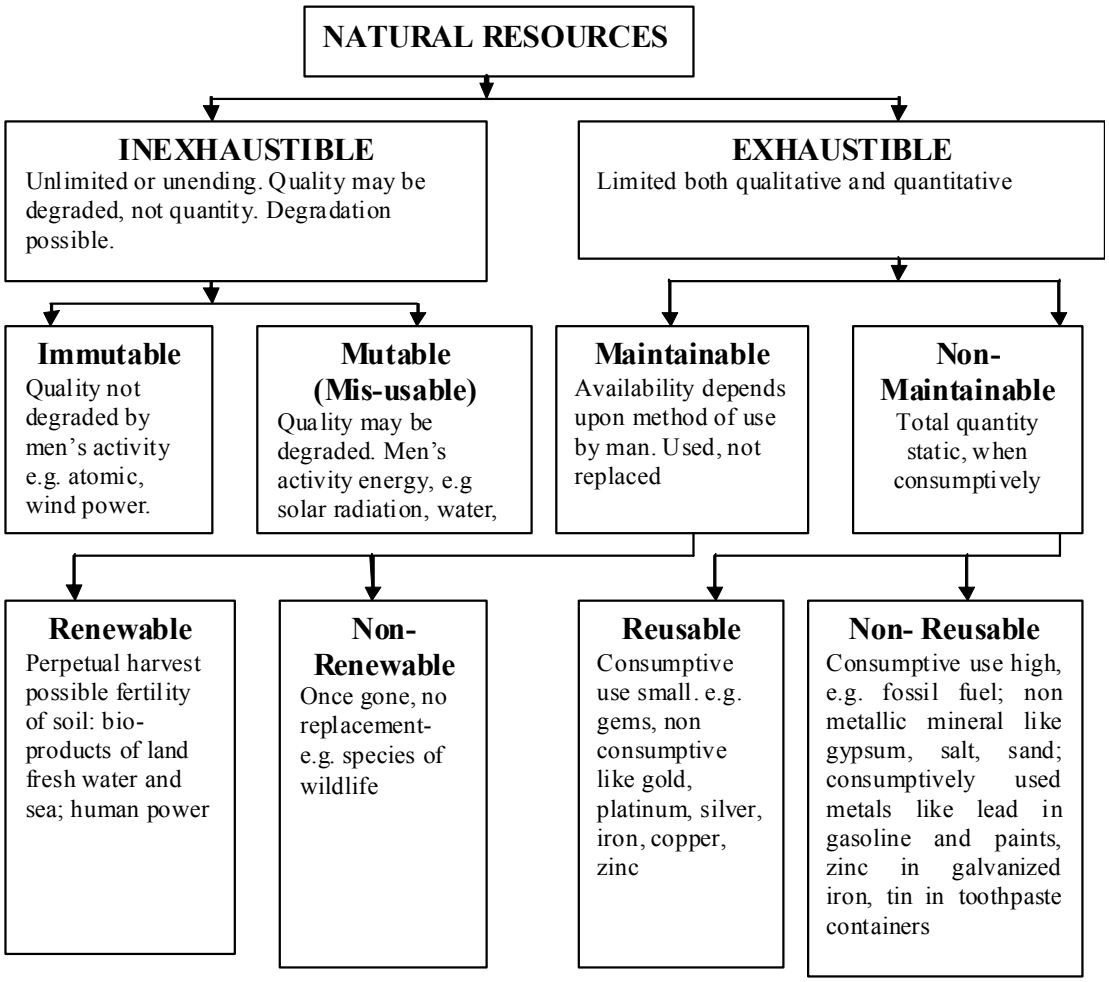
Some ecologists give subdivisions of resources include **Renewable** and **Non-Renewable Resources.**

Renewable Resources: Resources which are reproducible and are obtained from the biomass of living organism e.g. forests and fish.

Non-Renewable Resources: Resources which are not reproducible and are obtained from the finite non-living reserves are called non-renewable resources e.g. coal and metals.

Some ecologists prefer to classify resources, into **Biotic (or Living) Resources** such as forest, agriculture, fish, wildlife etc. and **Abiotic (or Non-Living) Resources** like land, water, minerals etc.

A Broader Classification of Resources Proposed by Owen (1971) is as Follows:



Systematic Representation of Classification of Natural Resources

1.4.4 HUMAN IMPACT ON NATURAL RESOURCES

With increasing human domination of earth's ecosystems, natural resources are declining both in quantity as well as quality on a global scale. Nearly half of the earth's surface has been transformed by human enterprises, such as agriculture, industry and commerce etc. The human appropriation of terrestrial net primary productivity is 39-50%; of the total accessible fresh water more than half is affected by human use; due to the human enterprises more nitrogen is fixed than by all natural terrestrial sources combined, the effect of which is being felt on varied natural resources; already about one-quarter of the bird species are gone and air chemistry is clearly different now than before industries began to expand dramatically. Recent studies indicate that nearly 50% of the natural vegetation on land has been transformed due to expansion of croplands, pastures, plantations and urban areas. Presently humankind is using 54% of all accessible freshwater and underground water resources are being depleted in many areas. About 22% of marine fisheries are overexploited and 47% of fisheries are at the limits of exploitation.

1.4.5 ROLE OF AN INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES

The resources are very valuable for us. However their increasing consumption, decreasing availability and their continuous consumption and their continuous degradation and depletion raise the urgent need of their conservation. Some natural resources are renewable while others are not, it is important to mention here that theses resources are not unlimited. Therefore due to there increasing demand, they are likely to be exhausted one day. So, we should use these resources judiciously and conserve them for future use. Resource conservation involves using, managing and protecting resources so that these will be available on a sustainable basis for present and future generations.

At a critical point, increasing pressure destabilizes their natural balance. Even biological resources traditionally classified as 'Renewable'- such as those from our oceans, forests, grasslands and wetlands, are being degraded by overuse and may be permanently destroyed. And no natural resource is limitless. 'Non-Renewable' resources will be rapidly exhausted if we continue to use them as intensively as at present.

The human population is increasing at a very fast rate as well as at the same time the human needs/requirements are also increasing. Therefore, more and more natural resources are required to meet the ever increasing human requirements. Our demands are unlimited but the resources are available in limited amount. Also, the natural resources are not distributed evenly on the earth. Thus, resources are consumed at a very fast rate. In other words, we can say that these resources are being over exploited. Today, many natural resources are being damaged as a result of human activities. The rapid rate of development, unplanned urbanization, over exploitation of natural resources cause air pollution, water pollution, deforestation, soil erosion, land degradation and green house effects etc.

Thus, the two most damaging factors leading to the current rapid depletion and degradation of all forms of natural resources are:

1. **Increasing 'Consumerism' on the part of the affluent sections of society, and**
2. **Rapid Growth of Population**.

Both factors are the results of choices we make as individuals. As individuals we need to decide:

- **What will we leave to our children? (Are we thinking of short-term or long-term gain?)**
- **Is my material gain, someone else's loss?**

Greed for material goods has become a way of life for a majority of people in the developed world. Population growth and the resulting shortage of resources most severely affect people in the developing countries. In nations such as ours, which are both developing rapidly, and suffering from a population explosion; both factors are responsible for, over exploitation of natural resources and environmental degradation. We must ask ourselves if we have perhaps reached a critical flash point, at which economic 'development' affects the lives of people more adversely than the benefits it provides.

1.4.5.1 NATURAL RESOURCES AND SUSTAINABLE LIVELIHOODS

Natural resource management is central to the achievement of most of the Millennium Development Goals. Natural resources provide food and a wide range of other goods (fuel, fodder, timber, medicines, building materials,

inputs to industries, etc). Natural resources provide services on which all human activity depends (including watersheds, carbon sequestration and soil fertility). Natural resource exploitation provides the livelihoods for a high proportion of the world's population. This includes not only agriculture in rural areas; 1.6 billion people rely on forest resources for all or part of their livelihoods, while around 150 million people count wildlife as a valuable livelihood asset and 200 million derive part or all their livelihood from fishing. Natural resources also provide opportunities for income generation through jobs and small enterprises (e.g. in forestry, tourism and wildlife trade).

Moreover, numerous studies have found that it is often the poorest people and households that are most dependent on these resources. "*Millions of rural South Africans depend upon biological resources for day-to-day survival. Access to this "natural capital" provides a crucial contribution to livelihoods, a buffer against poverty and an opportunity for self employment"*. Of the 1.2 billion people estimated to live on less than US$ 1 a day (i.e. those that are the target of MDG1), 70 per cent live in rural areas with a high dependence on natural resources for all or part of their livelihoods. But it is not just the rural poor who are reliant on natural resources – food, medicines and ecosystem services such as clean water supply also serve urban populations, and hundreds of millions of urban dwellers derive part of their income from urban agriculture or from industries or services that depend on agriculture, forestry or fishing.

1.4.5.2 CONSERVATION OF NATURAL RESOURCES

Prof. H. M. Rose defined conservation as *"the optimum allocation of natural, human and cultural resources in the scheme of national development, where by maximum economic and social security will be assured."*

We should protect the present resources and situation so that good, clean and self sufficient environment should be provided to the future generations also. Every human being has the right to live in a quality environment and his fundamental duty is to protect the environment and its surrounding. **So, every citizen is supposed to follow some norms for the conservation of natural resources.**

1.4.5.2a Conservation of Water Resources

Goethe rightly said that, "Every thing is originated in the water, and everything is sustained by water". Water is needed to fulfill diverse requirements in so

many diverse ways. There is an increasing stress on various water resources and they are degrading at a very fast rate. It is proper time that we should take special measures for conserving our water resources. Water is becoming scarce day by day and situation is very alarming in many parts of the world.

The following measures can be adopted to conserve water resources:

- Avoiding wastage of water by closing taps when water is not in use
- Renovate the tanks and stop leakages by promptly repairing them.
- Plug leakages in pipes, channels etc.
- Avoid showers and bath tubs as they need more water.
- Use buckets for bathing.
- Use displacement devices in toilet flushes.
- Harness River flows through bunding and diverting.
- Collect rain water in depressions.
- Use covered pipes for water distribution.
- Exploit ground water from potential areas like canal command areas.
- Water used from washing vegetables should be reused to irrigate kitchen gardens and lawns.
- Use dry clean streams for water distribution.
- Recharge rainwater into dry dug wells.
- Conserve water through ploughing.
- Using sprinklers and drip irrigation methods
- Minimizing run off by improving land preparation
- Development of crops which require less water
- Encouraging recycling of water in industries
- Using processes/ equipment/ technologies which require lesser amount of water.
- Repairing leaks frequently
- Using water efficient systems in toilets
- Rain water harvesting and water shed management

The **National Water Policy, 2002** also recognizes the need for well developed information systems at National and state levels and emphasizes on inter-basin transfers, artificial recharge, desalination of brackish or sea water and rain water harvesting for increasing utilizable water resources. It also stresses upon watershed management through extensive soil conservation, catchments area treatment, protection of forests and construction of check dams. It is the responsibility of every citizen to minimize the use of water and to protect water bodies from pollution.

1.4.5.2b Conservation of Energy

Conventional energy sources have a variety of impacts on nature and human society. India needs to rapidly move into a policy to reduce energy needs and use cleaner energy production technologies. A shift to alternate energy use and renewable energy sources that are used judiciously and equitably would bring about environment friendly and sustainable lifestyles. India must reduce its dependency on imported oil. At present we are under-utilizing our natural gas resources. We could develop thousands of mini dams to generate electricity.

India wastes great amounts of electricity during transmission. Fuel wood plantations need to be enhanced and management through **Joint Forestry Management (JFM)** has a great promise for the future. Energy efficient cooking stoves or 'chulas' help the movement of air through it so that the wood is burnt more efficiently. They also have a chimney to prevent air pollution and thus reduce respiratory problems. While over 2 lakh improved chulas have been introduced throughout the country, the number in active use is unknown as most rural people find it to be unusable for several reasons. The Tata Energy and Research Institute (TERI) in 1995 estimated that in India 95% of rural people and 60% of urban poor still depend on firewood, cattle dung and crop residue for cooking and other domestic purposes. Biomass can be converted into biogas or liquid fuels i.e. ethanol and methanol. Biogas digesters convert animal waste or agricultural residues into gas. This is 60% methane and 40% CO_2 generated by fermentation. The commonly used agri waste is dung of domestic animals and rice husk, coconut shells, straw or weeds. The material left after the gas is used as a fertilizer. Small hydrogeneration units are environment friendly. They do not displace people, destroy forests or wildlife habitats or kill aquatic and terrestrial biodiversity. It is easy to waste energy but cheaper to save it than generate it. We can conserve energy by preventing or reducing

waste of energy and by using resources more efficiently. People waste energy because government subsidises it. If the real cost was levied, people would not be able to afford to waste it carelessly.

Since energy has multidimensional uses, various measures in different sectors can be practiced to minimize the energy consumption. These are discussed below:

1. Residential and Commercial Measures

Everyone can conserve energy. Even small efforts collectively save a large amount of energy. Several initiatives at home, in offices, institutions, hospitals, hotels etc. can reduce energy consumption. These are as follows:-

- Switching off electrical appliances when not in use.
- Turn off lights and fans as soon as you leave the room.
- Use smokeless *chulhas*.
- Use pressure cooker and cover vessels while cooking.
- A pressure cooker can save up to 75 percent of energy required for cooking. It is also faster.
- Prefer natural light to artificial light.
- Use low wattage CFL bulbs (voltage).
- Switch off lights and power points when not in use.
- Use fluorescent lights as they consume less power.
- Keep the bulbs and tubes clean. Dust on tubes and bulbs decreases lighting levels by 20 to 30 percent.
- Switch off the television or radio as soon as the program of interest is over.
- Use solar gysers instead of electric ones.
- Modification of design of buildings so that they receive more natural light, heat and air.
- Developing more efficient energy gadgets.
- Using energy saver options and regulating devices in air conditioners, coolers and in other electrical appliances.

- Proper maintenance of electrical and other power consuming devices.
- Using alternative products whose manufacture requires lesser power consumption.
- Prefer power from renewable resources.
- Adopt bus systems to reduce traffic and consumption of fuel.
- Drive at fuel efficiency speed.
- Avoid using cars and walk whenever possible.

2. Transportation Measures

Transportation consumes a large amount of energy. A change in transport patterns, requirements and vehicles would significantly alter the energy requirement. Several measures such as follows can contribute to energy conservation in transport sector:

- Improving the design of vehicles to make them more energy efficient and less polluting.
- Use of more energy efficient fuels.
- Using personal car pools rather than single commuting.
- Switching over to efficient public transport systems such as metro trains etc.
- Reducing the number of kilometers to be traveled by proper planning.
- Proper maintenance of vehicles.
- Using good practices while driving.
- Building expressways and highways.
- Using better traffic management.

3. Industrial Measures

Industries heavily consume energy. Similar to the transport sector, the energy demands can be reduced in industrial sector in many ways. Some of these are listed below:

- Switching off equipment and devices when not in use.
- Using better house keeping practices and planning

- Using more efficient equipments, instruments and devices
- Using more energy efficient processes and technologies.
- Substituting and encouraging the use of products whose manufacture requires lesser energy.
- Recycling and using the waste products, heat and waste water in different processes and industries.

1.4.5.2c Conservation of Mineral Resources

Minerals are the non living substances obtained from the earth through the process of mining. Formation of minerals took place predominantly in weak zones like mountains, folded and faulted regions, lakes, troughs and commercial shelves through geological processes going on since billions of years. They hold some peculiar characteristic, such as exhaustibility, localized occurrence, international character, unpredictable occurrence which distinguish them from other natural resources.

Efforts to Conserve Mineral Resources Include:

- Application of efficient methods of mining to take out every possible tonnage lying under ground.
- Utilization of unmarketable ores through the innovative methods or ore dressing and metallurgical practices.
- Use and reuse of scraps.
- Recovering all associated elements as co product or byproduct.
- Economic use of minerals.
- Substituting the use of rare land costly minerals with those which are abundant and cheaper.

4.5.2d Conservation Measures for Eroded Lands

The following considerations are important in negotiating the eroded lands:

1. Ravines should be provided with sufficient and suitable vegetative cover.
2. Instead of agriculture, these lands should be reclaimed for forestry, pasture or horticulture.
3. Their deficiency in nutrients and moisture for plant growth should be improved.

4. Further misuse of such land should be prevented. Over trampling by man and cattle should be avoided.
5. Past damages should be repaired and recompensed under strict ecological conditions. For instance depressions may be filled up, slopes easened out, cattle, trials fenced etc.
6. Vegetative cover provided should be protected against reckless destruction by local population.

Measures for a greater and sustained agricultural production following considerations are important:

1. Available land acreage should be properly and judiciously utilized.
2. Soil fertility should be increased through wise use of fertilizers and organic matter.
3. High yielding and disease resistant plant varieties should be introduced.
4. Mixed cropping should be practiced wherever possible.
5. Integrated and balanced use of available water sources, surface and ground water should be used.
6. Weeds and pests should be efficiently controlled. Integrated pest control practice should be preferred over total reliance on chemical pesticides.
7. Soil erosion and loss of nutrients should be prevented through maintaining vegetation cover throughout the year.
8. Exotic varieties should be introduced only after due considerations of long term periods.

1.4.5.2e Conservation of Forests

A number of factors such as increased urbanization, industrialisation, construction, increased population, use of wood in domestic and commercial purposes as well as mining are responsible for depletion of forests.

Environmentally, forests are very important for balancing oxygen and carbon dioxide level in atmosphere, regulate earth's temperature regime and hydrologic cycle. Forests increase local precipitation and water holding capacity of soil, thus preventing drought situation. Vegetation cover provided by forest impedes the velocity of runoff on soil surface checks soil erosion, silting and landslides,

thus reducing the danger of flood. The litter from leaves maintains fertility of soil by returning the nutrients. Forests also act as refuge of wild animals and provided protection to them against strong cold or hot and dry winds, solar radiations, rain and enemies. The functions of the forest can be divided into following three categories:

1. Protective Functions: Theses include the protective role of forests against soil erosion, droughts, flood intense radiation etc.
2. Productive Functions: Forests are the source of wood and many other products like gums, resins, fibers, medicines, katha, honey, bidiwrappers, pulp paper etc.
3. Accessory Functions: These include the role of forests in recreation, aesthetics and as habitat of diverge wildlife etc.

1.4.6 EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFESTYLES

The concept of environment conservation, sustainability and survival which the modern ecologists are embarking upon, are inherent in the ideology of Mahatma Gandhi who was a man far ahead of his time and all the modern environmentalists. As early as in 1927, he had warned the world that large scale industrialism would create problems of type we are confronting today. Ecologists all over the world today seem to share Gandhian view that industrialist society is no longer sustainable however he was not against industrialisation but against industrialism and dehumanized machine culture.

Nature is becoming a victim of human greed. He was of the view that as long as the greed prevailed and the fruits of economic development were not shared equitably among the masses, poverty and hunger would exist and till the evils of hunger, malnutrition and exploitation of poor continued in any part of the world, there could be no economic stability and ecological sustainability. Poor people and poor nations tend to over exploit the resources in order to survive. Thus Gandhi focused on environmental friendly development with a human pace which lasts long for future generations and that is called sustainable development.

1.4.6.1 Meaning of Sustainable Development

The term sustainable development was coined by World Commission on

Environment and Development headed by Gro Harlem Brundtland, in the report 'Our Common Future, London, 1987. The *Commission* defined sustainable development as 'development that meets the needs of the present without compromising the ability of the future of generation to meet their own needs'. Turner (1988) said Sustainable Development involves, mixing the net benefits of economic development, subject to monitoring the services and quality of natural resources over time.

1.4.6.2 Model of Sustainable Development

Most of the developmental models, either economic or social or any other, lacking the 'environmental dimension'. To achieve Sustainable Development, there is a need to incorporate environment as an important component along with other components namely, Socio-Cultural, economic, technological and political. The dimensions are presented in a diagrammatic form (Fig. 1). Shaded portion of the model clearly depicts the position of sustainable development. It is the product of interactions of all components. This model's attention to the development process goes beyond a consideration of the socio-cultural, political, economic, technological and ecological components, stressing the external and internal environmental factors.

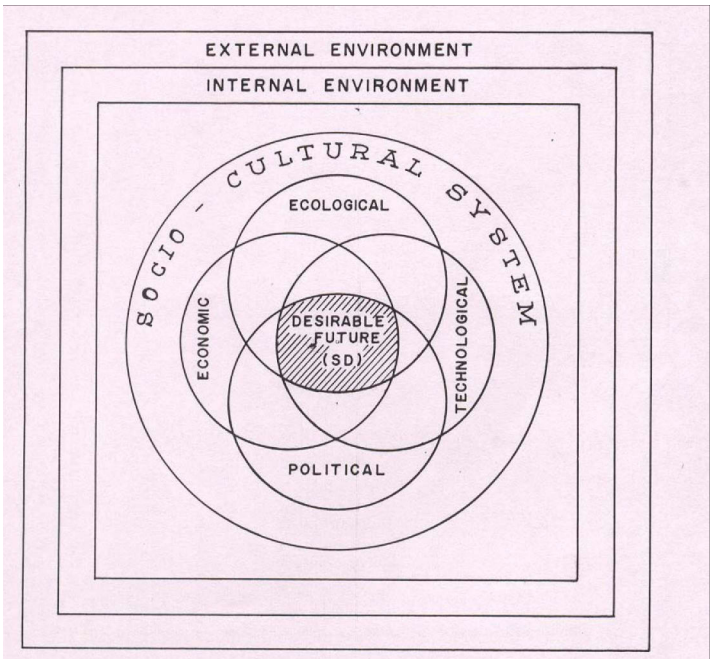


FIG. 1. CONCEPTUAL MODEL OF SUSTAINABLE DEVELOPMENT (SD)

1.4.6.3 Concept of Sustainable Lifestyles

Sustainable lifestyles are patterns of action and consumption, used by people to affiliate and differentiate themselves from others, which: meet basic needs, provide a better quality of life, minimize the use of natural resources and emissions of waste and pollutants over the lifecycle, and do not jeopardize the needs of future generations.

Sustainable consumption is related to the process of purchasing products and services, consuming and disposing, while sustainable lifestyles include a broader set of activities, such as interaction, leisure activities, sports and education, including, but not limited to, material consumption.

A focus on sustainable lifestyles takes the way we live as a starting point for capturing the environmental consequences throughout the lifecycle of everything we buy and use in our daily lives, and at the same time delivering a good quality of life for everyone. Taking a lifestyle perspective we focus on the actions of individuals and households. Whilst sustainable lifestyles provide a broad concept encapsulating more complex interactions about our consumer choices and behaviours, sustainable consumption is a subsequent effect of what we consume. A simple example might be that we choose to live close to where we work. Consequently, we might consume less petrol, or not need to travel by public transport on a daily basis. Our patterns of consumption are a reflection of our lifestyle.

Sustainable consumption refers to measures to achieve a more equitable distribution of consumption around the world and reduce the overall environmental impact. This requires an understanding of the impact from our consumption activities, which can be categorized as the food we eat, the homes we live in, how we travel and the stuff we buy. Both the direct and indirect impacts from these consumption activities need to be assigned to (e.g. households), such as emissions arising from fuel combustion in a household, and the indirect impacts embedded in products caused during the production of the goods and delivery of the services to the household, such as pesticide exposure during agricultural production or emissions from landfills. The government is also a significant consumer who must share the responsibility.

1.4.6.4 The Environmental Consequences of Our Lifestyles

The severity of our lifestyles on the planet is being felt and the world's climate

crisis is upon us. Science tells us that the accumulation of greenhouse gases in the atmosphere is causing global temperatures to rise, and having irreversible consequences on our planet.

Reduction of the unsustainable and unequal use of resources and control of our population growth are essential for the survival of our nation and indeed of human kind everywhere. Our environment provides us with a variety of goods and services necessary for our day-to-day lives, but the soil, water, climate and solar energy which form the 'abiotic' support that we derive from nature, are in themselves not distributed evenly throughout the world or within countries.

A new economic order at the global and at national levels must be based on the ability to distribute benefits of natural resources by sharing them more equally among the countries as well as among communities within countries such as our own. It is at the local level where people subsist by the sale of locally collected resources, that the disparity is greatest. 'Development' has not reached them and they are often accused of 'exploiting' natural resources. They must be adequately compensated for the removal of the sources to distant regions and thus develop a greater stake in protecting natural resources.

There are several principles that each of us can adopt to bring about sustainable lifestyles. This primarily comes from caring for our Mother Earth in all respects. A love and respect for Nature is the greatest sentiment that helps bring about a feeling for looking at how we use natural resources in a new and sensitive way. Think of the beauty of a wilderness, a natural forest in all its magnificence, the expanse of a green grassland, the clean water of a lake that supports so much life, the crystal clear water of a hill stream, or the magnificent power of the oceans, and we cannot help but support the conservation of nature's wealth. If we respect this we cannot commit acts that will deplete our life supporting systems.

1.4.7 CONCLUSION

In this chapter we have discussed various reasons for the overexploitation of natural resources as well as role of individual in the conservation of natural resources. Their overexploitation has in fact led to degradation and depletion of natural resources. Various natural resources such as land, soil, water, air, forests etc. are degrading as well as depleting very fast. There are various aspects of natural resource management viz. ecological, economic and ethnological.

In nutshell, the following measures can be used for the conservation and equitable use of resources for sustainable life styles such as reduction in consumption, more efficient use of existing natural resources, substitution of non-renewable resources by renewable resources, more use of abundant resources in preference to scarce resources, recycling and reuse as well as judicious use of natural resources with low/minimum wastage. If human beings use natural resources properly, wisely and efficiently, then they can live in harmony with the community and environment around them.

Glossary

1. **Conservation :-** The optimum allotment of natural, human and cultural resources in the scheme of national development, where by maximum economic and social security will be assured.
2. **Renewable resources :-** Resources which are reproduceable and are obtained from biomass of buring organisms e.g. forests and fish.
3. **Non-renewable resources :-** Resources which are not reproduceable and are obtained from finite non-buring reserves are called non-renewable resources e.g. coal and metals.

Lesson No. 1.5 Author: Amita Kaistha

ECOSYSTEM

Structure

1.5.0 OBJECTIVES

The scope of this lesson is to familarise students with the concept of an Ecosystem, structure & functions of an Ecosystem.

After going through this lesson the students will be able to:

1. Define ecosystem.
2. Understand the structure and function of ecosystem.
3. Differentiate between producers, consumers and decomposers.
4. Explain the flow of energy in the ecosystem.
5. Discuss ecological succession.
6. Describe food chains, food webs and ecological pyramids.

1.5.1 INTRODUCTION

Environmental studies is an integral part of education. It makes the students aware of various environmental problems. It not only brings out and discusses various causes of environmental problems but also suggests the means to solve the problems. It provides positive attitude and helps to develop eco-friendly (environment friendly) habits among students.

In order to achieve a sounder attitude towards environment as a whole, it is important that proper holistic knowledge regarding the environment be provided to the students.

1.5.2 CONCEPT OF AN ECOSYSTEM

The term Ecosystem was first used by A.G. Tansley in 1935. According to him an ecosystem is a peculiar category of physical systems, consisting of organisms and inorganic component in a relatively stable equilibrium, open and of various sizes and kinds. This term ecosystem comprised of two words Eco means 'environment' and System means 'an interacting, interdependent complex'.

An ecosystem includes all the communities of an area (all the micro-organisms, the plants and the animals) functioning with their non-living environment like soil, air and water. The various communities of living organisms interact among themselves and with environment. They interact with one another through food chains. Plant interact with soil to get essential nutrients like nitrogen, phosphorus etc., with air to get carbon-dioxide and also with water bodies for carrying out the process of photosynthesis.

Thus, the various communities of living organisms along with soil, air and water of that region form a self-sustaining independent unit called ecosystem. So, "An ecosystem is a relatively self-contained and distinct community of organisms

(micro-organisms, plants and animals) and their environment". In an ecosystem, energy and matter are continuously exchanged between its living and non-living components. It needs input of solar energy to function.

1.5.3 STRUCTURE AND FUNCTIONS OF AN ECOSYSTEM

Basically ecosystems are of two types:

(i) Natural Ecosystem –e.g. desert, ponds, grassland, forest etc.

(ii) Man made Ecosystem –e.g. Gardens, acquarium, crop, dam, village, etc.

1.5.3.1 Structure of an Ecosystem

An ecosystem is composed of the two major components as given below:

1.5.3.1.1 Abiotic Components

Abiotic means non-living. So abiotic components refers to non- living elements present in the ecosystem. Basic inorganic elements and compounds includes soil, water, oxygen, calcium carbonates, phosphates and various by-products of organic activities. Other physical factors viz. moisture, wind, currents and solar radiations also included in abiotic components.

1.5.3.1.2 Biotic Components

These include the living elements of the ecosystem and are divided into categories on the basis of their nutritional relationship.

They are grouped into three basic categories:

(i) Producers. - Autotrophic Components

(ii) Consumers - Heterotrophic Components

(iii) Decomposers

(i) The Autotrophic Components are those which are capable of synthesising their organic food from simple inorganic substances like CO_2, H_2O by process of photosynthesis e.g. Green plants, Cynobacteria etc. These are known as producers.

(ii) The Heterotrophic Components include those organisms which consume either readymade organic food or decompose the complex .organic compounds. These are called as consumers. **These are subdivided into two categories:**

(a) Macro Consumers

(b) Micro Consumers (Decomposers)

(a) Macro Consumers are further divided into following types:

Primary Consumers. These are also called consumers of first order. These includes the herbivores which directly eat upon the plants e.g. rabbit, deer, goat, cow, buffalo.

Secondary Consumer. In other words these are also known as consumers of secondary order. These includes the *carnivores* and *omnivores*. Carnivores are flesh eating animals whereas, omnivores are animals that consume flesh as well as plants. Example: Sparrow, Crow, Fox, Wolves, Dog, Cat, Snake, man etc.

Tertiary Consumers. These are third order consumers and also termed as top carnivores which prey upon other carnivores, omnivores and herbivores e.g. Lion, Tiger, Hawk, Vulture etc.

(b) Micro Consumers or Decomposers. Decomposers are living components of the ecosystem viz. bacteria and fungi which decompose the complex compounds of dead matter and absorb them. During this process of decomposing they produce the nutrients which are later taken by producers. The decomposers/ transformers play very important role in maintaining the ecosystem. So in this way energy obtained from the environment, released in the environment at the end and the cycle goes on.

1.5.3.2 Functions of an Ecosystem

The ecosystem constitutes the basic structural and functional unit of ecology in which the structural units are coherently interwoven through the functional attributes and thus deals with the principle of "wholeness" of the ecosystem. Functionally the system can conveniently be analyzed under following heads:

1. **Energy Circuit:** Solar energy captured by the producers, passes through various trophic levels of consumers and decomposers and gets dissipated. The ecosystem represents an open system through which the energy flows.

2. **Food Chains:** The organic matter produced by the producer is consumed by the consumers occupying different trophic levels. Thus, within the ecosystem there is a chain starting from producer to the 1st order consumer,

2nd order consumer, 3rd order consumer, the top carnivores and the decomposer.

3. **Nutrient (Biogeochemical) Cycles:** The material present on earth remain in constant flux with the living organisms. In this process the system acts as closed system and the material goes on circulating by passing from abiotic component to biotic component and back to the abiotic component of the ecosystem. Examples are Nitrogen cycle and phosphorus cycle on land, etc.

4. **Diversity:** The variations in both the abiotic as well as the biotic components occur both in time and space. Thus the variations are observed in biotic communities and environmental parameters from place to place and at a place from time to time, indicating ecosystem diversity in time and space.

5. **Development and Evolution:** The biotic communities and the abiotic parameters of the environment are in constant flux and are constantly influencing characteristics of each other. In this process the biotic communities remain in transition and exhibit development and evolution which has been called as succession.

6. **Control:** The biotic communities in transition with the abiotic environmental parameters remain under self-regulatory control mechanism modulated through cybernetic principles (self regulation through feedback) abiotic component to biotic component and back to abiotic component.

1.5.4 ENERGY FLOW IN THE ECOSYSTEM

Energy is the ability to do work. In the ecosystem solar energy is captured by the green plant during the process of photosynthesis and is transformed into chemical bond energy and gets stored in organic compounds produced. The behaviour of energy in the ecosystem follow the laws of thermodynamics.

(i) *First law of thermodynamics.* The law states that energy may be transformed from one type to another but is neither created nor destroyed. In the ecosystem light is transformed into heat, work or chemical bond energy in food.

(ii) *Second law of thermodynamics.* The second law states that the process

associated with energy transformation does not occur spontaneously and is associated with the degradation of energy from concentrated to a dispersed form. At each transformation some energy is always dissipated and hence no transformation is 100% efficient. The measure of unavailable energy resulting from transformation is termed 'Entropy' (en £ in ; trope £ transformation). lt also indicates the general index of disorder associated with energy degradation.

The relationships between producer and consumer, predator and prey, one trophic level to other trophic level and the number and kind of organisms in an environment are all limited and controlled by the same basic laws that govern non-living system.

The flow of energy through the ecosystem begins with the incorporation of energy in organic compounds during the process of photosynthesis. The energy accumulated during this process is known as *primary production*. The primary producers (green plants) require energy for the maintenance of their growth, development and reproduction which is supplied to them through the process of respiration. The energy remaining in the system i.e., net primary production is gross primary production-respiration. The net primary production on getting accumulated over a time is called plant biomass. The energy consumed by first order consumer is utilized in maintenance, growth, development and reproduction of the consumer and some portion of it is passed out of the body as excreta. The energy content of the excreta gets dissipated through detritus energy path, some of it is lost as fermentation gases. The part of energy content left in the body is utilized for basal metabolism and the energy incorporated within the body of the consumer is $1/10^{th}$ of the total energy ingested by it. Similar energy transfer takes place when it passes from first order consumer to second order consumer along the food-chain. The net energy of a balanced ecosystem remains constant and energy entering at the level of producer flows out of the system during this process the energy is utilized to maintain the structure and function of ecosystem.

1.5.5 FOOD CHAINS, FOOD WEBS AND ECOLOGICAL PYRAMIDS

1.5.5.1 Food Chains

Any food chain comprises a series of organism through which food energy is transmitted. Thus, food from one trophic level reaches to other trophic level and

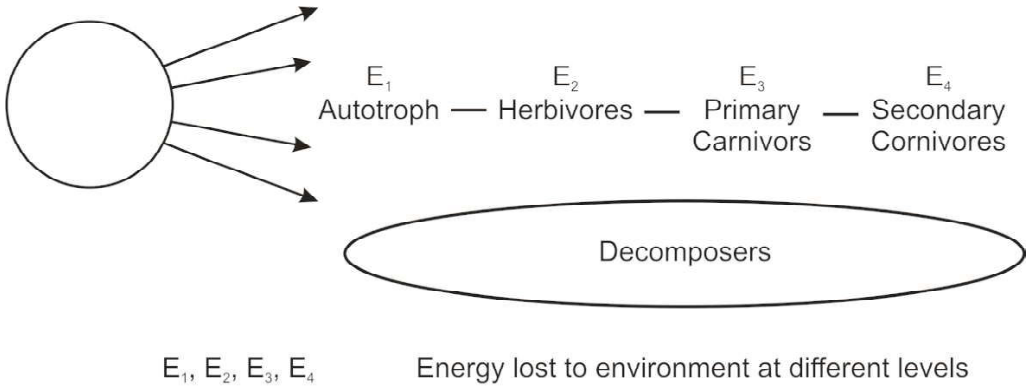
in this way a chain is established.

Food chains are of three types:

1. Grazing/Predator Food Chain
2. Parasitic Food Chain
3. Saprophytic or Detritus Food Chain

1. Grazing/Predator Food Chain

It starts from the base of green plants, goes to grazing herbivores (Plant eaters) and reaches to carivores (animal eaters). Most of the ecosystem have this kind of food chain and this food chain depends on solar radiation.



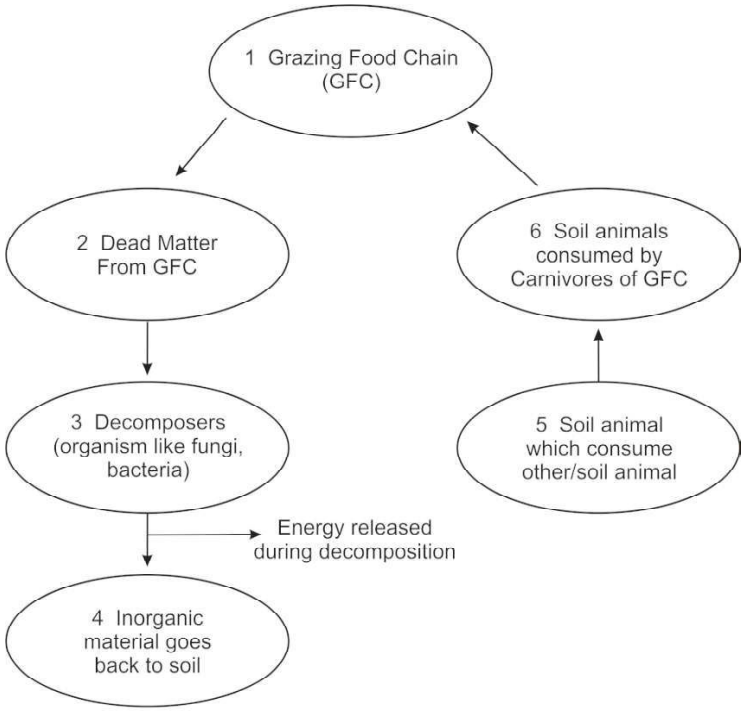
Diagrammatic of Grazing Food Chains (GFC)

2. Parasitic Food Chain

It goes from large organisms to smaller ones without outright killing.

3. Detritus Saprophytic Food Chain

Detritus food chain starts from dead organic matter and goes to micro-organism and then to detrivores. Such ecosystem are less dependent on solar energy.



Detritus Food Chain (DFC)

1.5.5.2 Food Webs

When number of food chains join together these make a food web.

In an ecosystem one organism does not depend wholly on another organism. Food web maintains stability of the consumer ecosystem.

1.5.5.3 Ecological Pyramids/Trophic Level

In food chains, there exist stages of food which constitutes levels. In these levels the lowest one is of Producers (P) where photosynthetic plants occur. Then occur the Primary consumers (C_1 Herbivores), Secondary consumers (C_2 Omnivores) and Tertiary consumers (C_3 Carnivores). According to Lindoran (1942), the basic principle in the pyramids is that the rate of production cannot be less but will be greater than the rate of secondary consumption. The Idea of Ecological Pyramids was advanced by C.E. Eltan (1927). There are different types of Pyramids according to the relation among the organisms at different levels in the ecosystem.

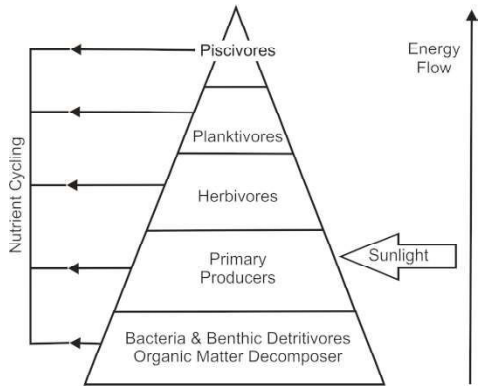
On the basis of this relation Pyramids are of three types:

(a) Pyramids of Number

(b) Pyramids of Energy

(c) Pyramids of Biomass

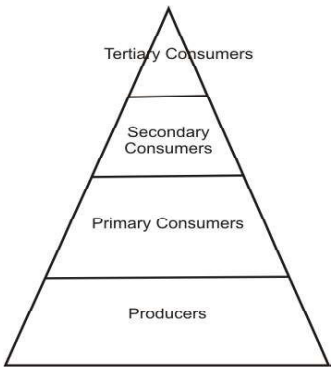
(a) Pyramids of Number : In it trophic level are more important than size. At each successive trophic level population decreases due to differences in population growth rate. For example in lake ecosystem more diatoms are occurred at base and copepods at second level are less abundant. Likewise third and fourth trophic levels are occupied by larger and smaller fish. It also see that there is increase in the size of the body from lower to higher level. It is inverted when number of individuals increased from base to Apex.



(a) Pyramids of Number

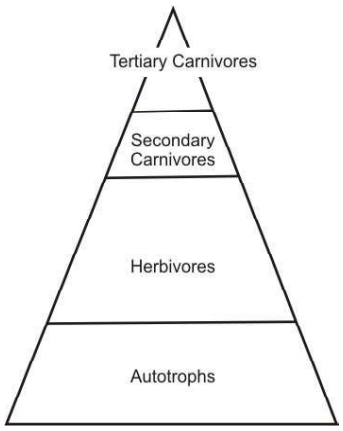
A pyramid of number may be spindle shaped. A tree can support a large number of birds. The birds are in turn eaten by carnivore birds which are smaller than the herbivore birds.

(b) Pyramids of Energy : The pyramid of energy indicates the reduction in the availability of energy in different trophic levels. The highest amount of energy is available at producer level (P) and decreases later on. The smallest amount of energy available for Tertiary consumers i.e. secondary carnivores.



(b) Pyramid of Energy

(c) Pyramids of Biomass : This pyramid shows the weight of the total bulk of organisms or fixed energy present at one time. This pyramid of biomass shows decrease in biomass from base to Apex. Some Energy is lost at each successive link. This shows usually sloping pyramid for most of the terrestrial sea-water ecosystem.



(c) Pyramid of Biomass

1.5.6 SUMMARY

We have discussed various basic concepts which are necessary to understand the concept of ecosystem. Ecosystem includes all the communities of an area functioning with their non-living environment like soil, air and water. These are of two types (i) Natural Ecosystem and (ii) Manmade Ecosystem. We have also

discussed the structure of Ecosystem which consists of abiotic components, biotic components, producers, consumers and decomposers. When food reaches from on trophic level to other trophic level a chain is established that is called as food chain. Food chains are of three types (1) Predator food chain, (2) Parasitic food chain and (3) Saprophytic food chain.

1.5.7 KEY CONCEPTS

1. Ecology - It is a study of structure and functions of ecosystem or nature.
2. Ecosystem - It is a functioning, interacting system composed of one or more living organisms and their effective environment both physical and biological.
3. Food Chain - The process of transfer of energy from producers to consumers and then to decomposers is called food chain.
4. Food Web - When various food chains become inter-related and overlap each other, this complicated food chain is called food web.

1.5.8 SELF-CHECK EXERCISE

Fill in the blanks:

1. The term Ecosystem was first used by .....
2. The various communities of living organisms along with soil, air and water form a self – sustaining independent unit called .....
3. Ecosystem is composed of two major components

(a) ..... (b) .....

4. Plants are the first ..... in food chain.
5. The food chain is affected by ..... activities.
6. The idea of Ecological Pyramid was advanced by .....
7. Ecological Pyramids are also called as .....

Answers: (1) A.G. Tansley (2) Ecosystem (3) Abiotic and biotic (4) Producers (5) Man (6) C.E. Eltan (7) Trophical levels

1.5.9 SUGGESTED QUESTIONS

Q.1. What is an Ecosystem? Discuss its structure and functions.

Q.2. Write short notes on:

(a) Abiotic Components

(b) Food Web

(c) Food Chain

(d) Ecological Pyramids or Trophic levels

1.5.10 SUGGESTED READINGS AND WEB SOURCES

1. Environmental Studies - R.R. Das

2. Environmental Education - R.A. Sharma

3. Basics of Environmental Education - Rajinder Kaur & Paramvir Singh

4. Environmental Education - R.C. Sharma & Gurbir Sangha

Web Sources:

1. edugreen.teri.res.in

2. en.wikipedia.org

3. books.google.co.in

Lesson No. 1.6 Author: Dilraj Singh

ECOSYSTEM AND ITS TYPES

1.6.0 OBJECTIVES

The scope of this lesson is to familairse the students with the concept of an Ecosystem, Ecosystem structure & types of Ecosystem. After studying this lesson students will be able to understand.

* Concept of an Ecosystem.
* Structure & types of Ecosystem.

1.6.1 INTRODUCTION

In nature an organism does not exist in isolation; it is associated with organisms of its own and of different kinds (communities) as well as with the physio-chemical environment (habitat). If the organism is a plant, it depends for its growth on the aerial environment for light, temperature and CO_2, on the soil environment for inorganic nutrients and water. If it is an animal it depends on the plants for food and often for shelter. If it is a microorganism it depends on dead organic matter from plants and animals for its food, and releases the nutrients tied in the organic matter for reuse of plants. There are, thus,

continuous and causal interactions among the organisms and between the organisms and the habitat resulting into an integrated, functional unit.

1.6.2 ECOSYSTEM – CONCEPT

To understand the meaning of Ecosystem, firstly we need to understand the broader term Ecology. **Ecology** is the science which investigates the relationships of living organisms to each other and their surroundings (abiotic and biotic). The term Ecology was first used by **Ernst Haeckel** in 1869 and is derived from word '***oikos'*** or 'living space' and '***logos'*** meaning 'the study of'. The organisms living on the surface layer of earth form the biosphere and are found in the air namely atmosphere, on the land the lithosphere and in the water the hydrosphere. On the global scale, land environments with similar plant and animal communities form natural regions or biomes. Each biome may be derived, at a variety of scales, into ecological systems or ecosystems. Each ecosystem has a unique range of species forming its biological diversity or biodiversity. This unit was termed, **Ecosystem** by **A.G.Tansley** (1935), who defined it as:

"a particular category of physical systems of organisms and inorganic components in a relatively stable equilibrium, open and of various kinds and sizes."

And *"a system resulting from the integration of all living and non-living factors of the environment."*

Later **E. P. Odum** (1953) firmly established the concept of ecosystem in ecological literature and defined it as a

"Basic functional unit of nature which includes organisms and their non-living environment, each interacting with each other and influencing each others properties, both are necessary for maintenance and development of system."

Later Odum (1971) gave a more elaborate definition as

"Any unit that includes all of the organisms (i.e. the community) in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles (i.e. exchange of material between living and non-living parts) within the system is an ecological system or ecosystem."

Definition of Ecosystem by I. G. Simmons

"A unit of space-time containing living organisms interacting with each other,

and with their abiotic environment by the interchange of energy and materials".

1.6.2.1 Ecosystem categories

Ecosystems can be put under two major categories:

(A) **Natural Ecosystems:** - They develop and operate under conditions created in natural way. They are of two types and further divided into sub types:-

1. **Aquatic ecosystem**: - It is of two types:-

   (I) **Fresh water ecosystem**: - It is of two types:-

   (a) **Lotic**: - Ecosystem of running water such as rivers.

   (b) **Lentic**: - Ecosystem of still water such as ponds or lakes.

   (II) **Marine Ecosystem**: - It is of three types:-

   (a) **Shallow Water Ecosystem**: - Ecosystem along the coastal line tidal zones.

   (b) **Deep sea ecosystem**: - Ecosystem beyond the coastline.

   (c) **Estuarine Ecosystem**:-River mouth ecosystem.

2. **Terrestrial Ecosystem**: - It is of six types:-

   (I) **Grassland ecosystem**: - they are dominated by grasses e.g. *Cynodon*, *Digitaria*, *Eleusine*, *Dicanthium*, *Setaria*, *Aristida*, *Andropogon* etc. They cover about 20% of the land surface.

   (II) **Savanna Ecosystem**: - They are grasslands with low frequency of trees on whose basis they are named.

   (III) **Taiga ecosystem**: - They are sub alpine ecosystems with low or sub medium rainfall, having humus and peat on the ground. The soil is acidic.

   (IV) **Tundra Ecosystem**: - They occur in alpine zone between taiga and polar ice zone. They are dominated by lichens, mosses, herbs, grasses and low shrubs.

   (V) **Desert Ecosystem**: - They are dry areas with very low rainfall, while warm deserts occur in the tropical zones, cold deserts occur in temperate zones. The Indian Thar desert of Rajasthan is a hot desert.

(VI) **Forest Ecosystem**: - They are found in tropical as well as temperate zones. The tropical forests may include deciduous trees or evergreen trees. The temperate forest generally consists of deciduous trees.

(B) **Artificial Ecosystems**:-

They are manmade ecosystems such as crop land ecosystems. Odum (1959) classified ecosystem on the basis of photosynthesis respiration (P/R) ratio as under:-

(i) **Stabilized system**: - When (P/R) ratio is almost one.

(ii) **Autotrophic system**: - When (P/R) ratio is more than one.

(iii) **Heterotrophic system**: - When (P/R) ratio is less than one.

1.6.3 ECOSYSTEM STRUCTURE

The ecosystem can be visualized as having two major kinds of components:

(1) Abiotic (non-living) and

(2) Biotic (living) components (Fig 1).

Ecosystem structure sometimes can be referred to as ecotype and *biocoenosis* respectively. The climate (*climatope*) and soil (*edaphotope*) factors are dealt within the abiotic and the plants (*phytocoenosis*), animal (*zoocoenosis*) and microbial (*microbocoenosis*) life are dealt within the biotic components.

1.6.3.1 Abiotic components

The abiotic components of structure is characterized by

(1) The quantity and distribution of non-living materials (inorganic substances e.g. C, N, CO_2, H_2O etc. and the organic compounds e.g. proteins, carbohydrates, humid substances) and

(2) The climate regime, such as temperature, light etc.

1.6.3.2 Biotic Components

The organisms that make up the living part of the ecosystem (biotic community) are divisible into two major categories, viz., autotrophs (producers) and heterotrophs (consumers). This division is based on the function of the organisms and not on taxonomy. *Autotrophs*, the green plants and the algae (and the autotrophic bacteria), by capturing the solar energy and utilizing the simple inorganic substances, manufacture the food, that is utilized by the heterotrophs,

which cannot manufacture their own food. The heterotrophs are divisible again into *phagotrophs* (phago-to eat) or macro-consumers and *microconsumers* or saprotrophs (sapro-to decompose). The former include chiefly the animal that ingests other organisms or particulate organic matter. The saprotrophs chiefly include bacteria and fungi which break down complex dead protoplasm, absorb some of the decomposition products, and release inorganic nutrients that are reused by the producers; they are also called decomposers. The phagotrophs may be herbivores (ingesting plants e.g. goat, deer) or carnivores (ingesting other animals- e.g. tiger, lion) or omnivores (ingesting both plants and animals e.g. bear, man).

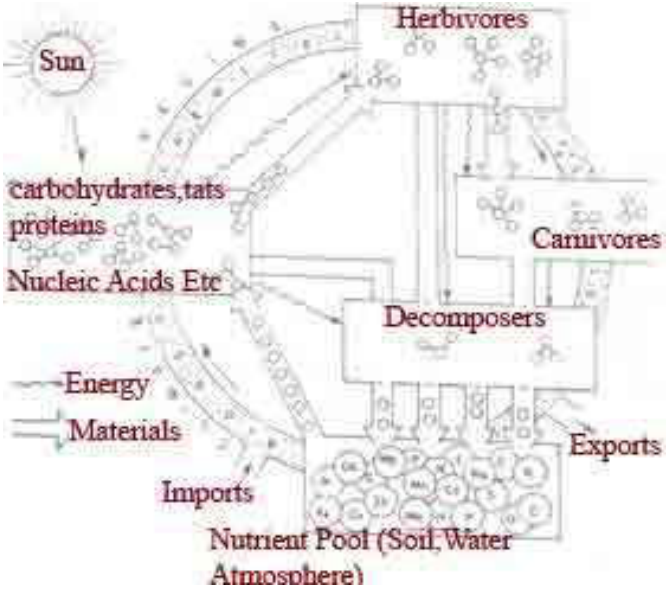


Fig 1A generalized model of an Ecosystem to show its structure and function.

The Ecosystem Nutrient Cycle Model

The ecosystems occupy arbitrarily defined volumes of the biosphere at the earth-atmosphere interface. The boundaries of an ecosystem are frequently defined by the boundaries of a biological community, e.g. forest ecosystem, grassland ecosystem, and sometimes by the boundaries of the physical environment, e.g. lake ecosystem. The ecosystems are open systems and they participate in the various larger biogeochemical cycles through a system

of inputs and outputs. The pathways of loss and replacement of nutrients connect one ecosystem with another (Fig. 2).

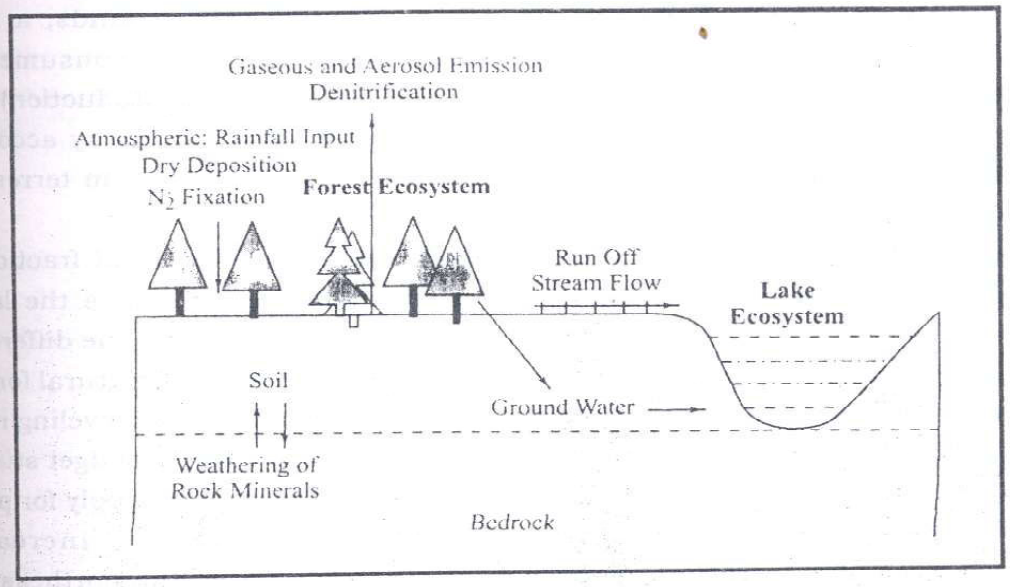


Fig 2. The pathway of nutrient movement connecting ecosystems

Fig 2. The pathway of nutrient movement connecting ecosystems

The inputs into an ecosystem are derived from meteorologic (e.g. nutrients in gases, precipitation, dust etc.), geologic (dissolved or particulate matter carried in through water and soil movements e.g., renewal of floodplains nutrients), and biologic (e.g., deposition of material by animals gathered elsewhere) sources. Similarly, nutrients leave the ecosystem (outputs) through meteorologic (e.g. deposition of material by animals gathered elsewhere) sources. Similarly, nutrients leave the ecosystem (outputs) through meteorologic (e.g., transport of gases and particulate matter), geologic (e.g, dissolved and particulate matter in moving water and soil), and biologic (removal by animals and humans) pathways. These inputs and outputs constitute the extra system nutrient transfers or extra system nutrient cycling which effectively connect different ecosystems.

Within an ecosystem e.g., a terrestrial ecosystem, we can visualize nutrients residing in five compartments viz., plant biomass, animal biomass, detritus, soil and rock minerals and available nutrients (Fig 3). Nutrients move from the soil compartment to the plants through root uptake from available nutrient pool, and then move to the animal and detritus compartments. Some nutrients are recycled within the plants (internal cycling) by resorption during senescence. Detritus from the plant and animal compartments is decomposed in the soil, releasing nutrients for further uptake by plants. The nutrient cycling within an ecosystem is called intra system cycling. In some ecosystems, nutrient transfers through the animal compartment can be particularly important For example , in productive grazed lands, a large proportion of plant production (including associated nutrients) is consumed by herbivores (sometimes more than 90% of the entire aboveground production) and nutrients are subsequently deposited in faeces and urine. Also, herbivory accounts for a three-fold greater proportion of nutrient transfer in pelagic than in terrestrial ecosystems.

The extrasystem transfers of nutrients account for only a small fraction of quantities that are cycled through the intrasystem cycling, and hence the latter tends to be a closed system particularly in mature ecosystems, where the difference between the input and the output tends to become negligible. Mature natural forests and woodlands have nearly balanced budget and can attain nutrient recycling rates up to 90%, as in the case of rainforests of Panama. The ecosystem N budget studies also show that N_2– fixation is only a minor contributor to the total N supply for plant growth in ecosystems with successionally mature vegetation. Increased anthropogenic inputs of N in recent years (e.g., 10-20 $g/m^2/yr$ in the northeastern United States and 50-100 $g/m^2/yr$ in central Europe) are, however, tending to make the intrasystem N cycle, a relatively more open system. The intrasystem cycling is also relatively more open in grasslands, aquatic ecosystems and disturbed forest ecosystems, where ecosystem inputs and outputs constitute a good proportion of nutrients being cycled.

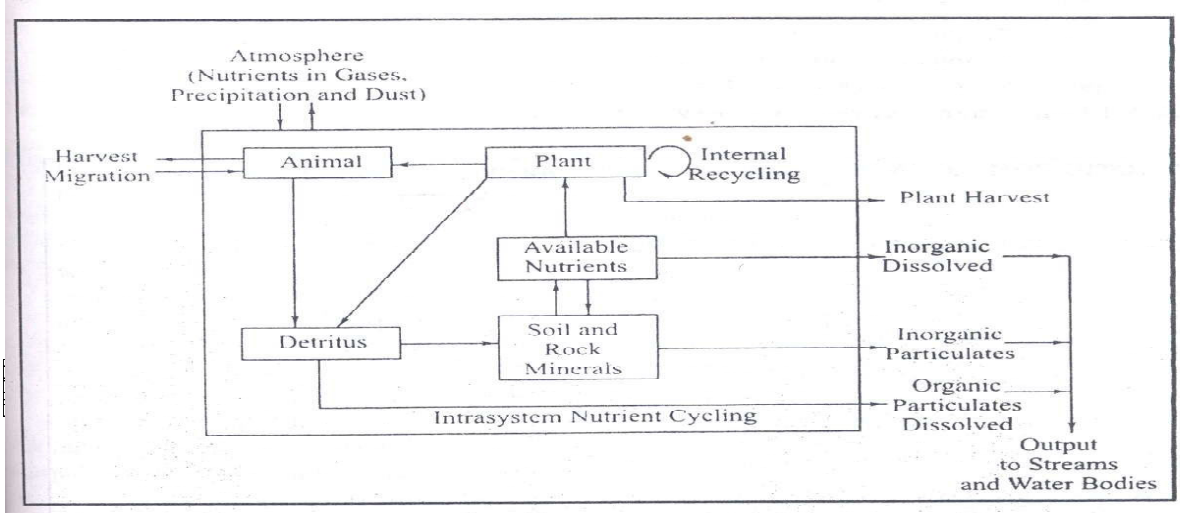


Fig 3.-A compartment model of intra system cycling of nutrients and extrasystem nutrient transfer.

1.6.4 TYPES OF ECOSYSTEM

- Forest Ecosystem
- Grassland ecosystem
- Desert
- Aquatic (Pond, Stream or River, Estuary, Lake, Ocean)

1.6.4.1 Forest Ecosystem: Forests are natural plant communities with dominant phanerophytes and occupy nearly 40% of the land area. In India forests occupy nearly 19% area of land. Eleven different forest types have been identified in India based on the physiognomy, physiography, floristics and habitat.

Major types of forests are:-

(1) North Coniferous, Boreal or Taiga Forests.

(2) Temperate Deciduous Forests

(3) Temperate Evergreen Forests

(4) Temperate rain forests or Moist Temperate Coniferous forests

(5) Chaparral

(6) Tropical Scrub or Thorn Forests

(7) Tropical Forests

(8) Tropical Deciduous Forests

(9) Tropical Evergreen Forests

1.6.4.1.1 Components of Forest Ecosystem

ABIOTIC COMPONENTS	Inorganic and organic substances in soil and atmosphere, including heat, light, rainfall and minerals etc.	
BIOTIC COMPONENTS	**PRODUCERS**	Plants e.g. Tropical rain forests, Temperate coniferous forests, temperate deciduous forests.
	CONSUMERS	
	PRIMARY CONSUMERS	Herbivores e.g. beeteles, flies, leaf-hoppers, bugs, spiders and animals e.g. Elephants, deer, moles, squirrels etc.
	SECONDARY CONSUMERS	Those which feed on herbivores e.g. - Snakes, lizards, etc.
	TERTIARY CONSUMERS	Top Carnivores-Lion, Tiger etc.
	DECOMPOSERS	Microorganisms like bacteria e.g. *Bacillus, Pseudomonas,* Actinomycetes and Fungi- *Fusarium, Aspergillus.*

1.6.4.2 Grassland Ecosystem

It is a terrestrial ecosystem occupying fewer areas. Grasses are a major subtype of herbaceous plants, may be annuals, with a life cycle completed in one year, biennials which begin their growth in one year and flower and produce seed in the following year and perennials which grow for several years. They occupy nearly 17% of earth's surface.

The various components of a grassland ecosystem are as follows:-

1.6.4.2.1 Abiotic component

These are the nutrients present in soil and the aerial environment. Thus the elements like C, H, O, N, P, and S etc. are supplied by carbon dioxide, water, nitrates, phosphates and sulfates etc., present in air and soil of the area. Moreover, in addition to the above, some trace elements are also present in soil.

1.6.4.2.2 Biotic Component

These may be categorized as:-

Producers:-

They are mainly grasses as species of *Dichanthium*, *Cynodon*, *Desmodium*, *Digitaria*, *Brachiaria,* etc. Besides them a few forbs and shrubs also contribute to primary production.

Consumers:-

These occur in the following sequence:

Primary Consumers are herbivores feeding on grasses such as grazing animals as cow, buffaloes, deers, sheep, rabbit etc. Besides them, there are also present some insects as *Leptocorisa*, *Dysdercus*, *Oxyrhachis*, *Coccinella*, some termites and millipedes etc, that feed on the leaves of grasses.

Secondary Consumers are the carnivores feeding on herbivores. These include the

Functions of Grassland Ecosystem:-

(1) Grasslands support large and small herbivores, mammals, birds and insects.

(2) Grazing decreases the number of carnivores birds but increases that of granivorous (feeding on grains and seeds)

(3) Some time grasshoppers do irreparable damage to the vegetation. Ants increase primary productivity by mixing organic matter and nutrients in root zone.

(4) Earthworms are abundant and help in decomposition. Besides, being intermediate several stages in succession, grasslands are the climax community in a diverted sere.

1.6.4.3 Desert Ecosystem

The areas with an annual rainfall of less than 25cm are called as Deserts. Deserts are sandy rocky and dry with very high temperature and sparse vegetation. Some deserts areas do not receive rainfall for many years. In hot deserts the day temperature is 50°c or more and night temperature is low. They occupy about 17% of the land. The *true deserts* are primarily subtropical, occurring generally in climates drier than those of semi desert scrub. In extremely arid climate, with precipitation

below 12 cm per year, vegetation cover is very sparse and the bare ground surface (sand, stone and salt crust) vast. Plant forms range from typical low shrubs, to some very distinctive plants and lichens in areas with fog. True deserts are always poor; both in flora and fauna. The vast land area of Sahara in Northern Africa, the Arabian Peninsula, the west coast of South America, and parts of Australia, India and southwestern United States are the typical areas of true deserts.

Warm deserts occupy large areas also in South America (from Argentina through Chile to Peru), in surrounding areas of Sahara in Northern Africa, and in areas of Arabian peninsula, Iran and the Thar desert of India. In this biome, as the data for North American semi deserts indicate, annual precipitation is between 5-30 cms, and the summer mean maximum and minimum temperatures are between 34-40°c and 19-26°c, respectively.

1.6.4.3.1 Abiotic Components

The abiotic factors of such an ecosystem include soil (sand), sunlight, temperature, air and water. The winds, scarcity of water, high temperature, heat and land covered with sand makes the habitat fit to those kinds of animals which can survive such extreme climatic conditions. Therefore, we mostly find animals like camels, sand boa, scorpions, lizards, insects, coyotes, and eagles. A few plants like cactus and other species of succulent plants that are adapted to hot and dry conditions are found in the deserts.

1.6.4.3.2 Biotic Components

The various biotic components of this ecosystem are as follows:-

Producers: These are shrubs, a few species of grasses, trees and succulent plants live in desert ecosystem. The shrubs have widespread, branched root system with their stems and branches variously modified. Sometimes a few succulents like cacti are also present. Some lower plants like lichens and xerophytic mosses may also be present.

Consumers: Insects, reptiles, nocturnal rodents, birds, camels etc. are part of consumers which are able to live under xeric conditions. In additions to them, there are also found some nocturnal rodents and birds. The '*ship of desert*', camels feed on tender shoots of the plants.

Decomposers: Desert is generally poor in vegetation and with very low amount of dead organic matter. The decomposers are few species of bacteria and fungi and most of them are thermophillc.

1.6.4.4 Aquatic Ecosystems

Aquatic ecosystems contain plenty of water, but light and oxygen are deficient. Temperature changes are less and surface of water develop waves.

Depending upon their size and habit the organisms found in the aquatic ecosystem are as follows:-

1. **Plankton :** Small microscopic plants (phytoplanktons) or animal (zooplankton).
2. **Neuston :** Large floating organisms are epineuston-living on water surface, hyponeuston- hanging from water surface.
3. **Nekton :** the Organisms that swim inside water.
4. **Periphyton :** Organisms attached to submerged vegetation above the bottom.
5. **Benthos :** Organisms confined to the bottom.

1.6.4.4.1 Aquatic ecosystem is of two types

1. **Fresh water Ecosystem**: it is of two types:

(a) **Lotic**: Ecosystem of running water such as rivers.

(b) **Lentic**: - Ecosystem of still water such as ponds or lakes.

2. **Marine Water Ecosystem:-** it is of two types

(a) **Shallow Water Ecosystem: -** Ecosystem along the coastal line tidal zones.

(b) **Deep Sea ecosystem: -** Ecosystem beyond the coastline**.**

(c) **Estuarine ecosystem:-** River mouth ecosystem

1.6.4.4.2 Pond Ecosystem

Permanent ponds have stable community unlike temporary ponds.

1.6.4.4.2.1 Abiotic components:

Quantity and quality of, water, temperature, PH, oxygen content, CO_2 content, and inorganic salts determine the productivity of biotic components.

1.6.4.4.2.2 Biotic components

(1) **Producers**:- Green Plant like:-

(i) **Phytoplanktons**: - e.g. *Oedogonium*, *Zygnema*, *Spirogyra* etc.

(ii) **Free floating macrophytes**: - e.g *Salvinia*, *Azolla*, *Lemma* etc.

(iii) **Anchored submerged macrophytes**: - e.g. *Chara*, *Hydrilla* etc.

(iv) **Floating leaved anchored macrophytes**: - *Nelumbo*, *Nymphea* etc.

(v) **Emergent macrophytes**: - Grow near banks e.g. *Sagittaria*, *Phargmites* etc.

(2) **Consumers**

(i) Primary consumers include zooplankton that feed on phytoplankton e.g. *Amoeba*, *paramecium*, *Cyclops*, *Daphina* etc. and some larval, tadpoles, fishes, bugs, beetles, insects etc.

(ii) Secondary consumers are frogs, bugs, fishes and insects.

(iii) Tertiary consumers include large carnivores fishes and birds (King fisher, stork).

(iv) Detritivores (Scavengers) they occur on the bottom of pond ecosystem (benthos) e.g. Chironomous larva, water skaters, worm beetles and small fishes.

(3) **Decomposers**: They include fungi, bacteria and Actinomycetes. During the process of decomposition many minerals are released. They are present on the bottom of the pond.

1.6.4.4.3 Stream or River Ecosystem

It is flowing water ecosystem. Plant growth is possible in plains only and not in the hills. It has uniform oxygen tension and no thermal or chemical zonation. Sometimes muddy water of rivers do not allow light penetration so producers are fewer in number and are mainly phytoplankton e.g. *Cladophora*, aquatic mosses and submerged plants. Marshy banks show presence of reeds. Consumers include larvae, snails, some fishes, crustaceans, crocodiles and few mammals. They may exhibit longitudinal zonation instead of horizontal zonation.

1.6.4.4.4 Estuary Ecosystem

Estuaries are areas where freshwater meets the saltwater of the sea. The result is brackish waters that support a high diversity of life. Estuaries trap nutrients coming into the environment from the ocean, land and inflowing rivers. These nutrients are dispersed throughout the estuary through tidal movement, wind and currents. This constant mixing creates a productive environment that

provides important habitat for many plants and animals. Estuaries themselves can incorporate many other habitat types including salt marshes and scrub forests.

1.6.4.4.4.1 Importance of Estuary Ecosystem in Nature:

- Provide important habitat to plants, shorebirds and other wildlife.
- Stop over areas for migratory birds.
- Food source for wildlife (due to the high productivity of the ecosystem).
- Sequesters and detoxifies wastes.
- Cycles nutrients
- Supports and provides opportunities for fisheries.
- Recreation opportunities, relaxation, and tourism opportunities.

1.6.4.4.4.2 Threats to Estuary Ecosystems

- Industrial and urban development
- Habitat conversion
- Elimination of wetlands in proximity to estuaries.
- Pollution, toxins entering the estuary
- Dredging
- Logging activities
- Pulp and paper mills
- Fish processing
- Ocean transport and navigation corridor maintenance.

1.6.4.4.5 Lake Ecosystem

The oceans banks of the lakes form the littoral area. Deep lakes show both photic (photic and profendal) and thermal generation like, epilimnion, matalimnion and hypolimnion.

Epilimnion- upper stratum of water, which is exposed to solar radiations warm in summers and cold in winters.

Metalimnion- Transition zone between epilimnion and hypolimnion.

Hypolimnion- Basal layer, water is always cool.

In temperate lakes, surface layers of water begin to cool off during autumn and springs the temperature rises again. Such temperature differences cause mixing or circulation of water and air. Such lakes having twice circulation of temperature or water are called dimectic. In tropical lakes this mixing of water occurs once a year such lakes are called monomictic. On the basis of productivity lakes are of two types oligotrophic and eutrophic oligotrophic lakes support very few plants and animals etc. Saline Sambhar lake of Rajasthan where few blue green algae like *Spirulina*, *Anabaenopsis* and few brine shrimp and brine flies grow.

1.6.4.4.6 Ocean Ecosystem

It comprises about 70% of the earth's surface. The water is latish with an average mineral content of 3.5 % (salinity is maximum at horse latitude 30°N to 30°S and lowest near poles).

Ocean is divisible in four regions:-

(1) Continental Shelf: - Submerged part of mainland (150-200m deep). It is divisible into three parts:-

(2) (i) **Supratidal** (supra littoral)-Beach area up to the edge of sea.

(ii) **Intertidal** (littoral) zone: - Area between upper the lower limit of tides.

(iii) **Subtidal** (sub-littoral) zone:- Ocean between the lower limit of the intertidal area to the edge of continental shelf.

(3) Continental slope (Bathyral zone):- It is a slanting area beginning from the edge of the continental shelf to the plain bottom of the ocean. (200m to 200m-4000m deep in ocean).

(4) Abyssal region: - The bottom region of the open sea which reaches a depth of up to 6 km.

(5) Hadal region: - They are deep trenches in the bottom of open sea. (As low as 10 km).

1.6.5 SUMMARY

In this chapter we have discussed the concept, characteristics, components, structure categories of ecosystem. Forest, Desert, Grassland and Aquatic (Pond, Stream Lake, Ocean, River, Estuary) ecosystems have been discussed in detail with special reference to their components (biotic and abiotic). We learnt that

the ecosystem is the basic functional unit of nature which includes organisms and their non-living environment, each interacting with each other and influencing each others properties, both are necessary for maintenance and development of system.

1.6.6 SUGGESTED READINGS & WEB SOURCE

1. Environment Studies : R.R. Das
2. Environment Education : R.A. Sharma
3. Basics of Environment Education : Rajinder Kaur & Paramvir Singh
4. Environmental Education : R.C.Sharma & Gurbir Singh

WEB SOURCES

1. edugreen.teri.res.in
2. en.wikipedia.org
3. books.google.co.in

1.6.7 SUGGESTED QUESTIONS

Q.1. Explain the concept & structure of Ecosystem ?

Q.2. What are the types of Ecosystem discuss in detail ?

Q.3. Explain biotic and abiotic components of ecosystem.

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BIODIVERSITY (I)

[Introduction, Values, Threats and Conservation.]

Structure:

1.7.10 Suggested Readings and Web Sources

1.7.0 Objectives

After going through this lesson students will be able to

1. Define Biodiversity
2. State the levels of Biodiversity
3. Analyse the value of Biodiversity
4. Explain the threats to Biodiversity
5. Discuss the measures of conservation of Biodiversity

1.7.1 Introduction

There is need to make our younger generation aware about the concept of biodiversity. Earth is the only planet where life is possible & this is because of its favourable climate which supports life. India has a great wealth of biodiversity in its forests, wetlands and marine areas. Owing to its diverse climate and physical conditions, India has a very rich and varied flora and fauna. Although they have many variations, but they all have the same life span. Inspite of all the differences, human beings, animals, birds & plants are all dependent on each other and are also interconnected at the same time. The need of the hour is to learn the various values which biodiversity teaches to the human beings and to make people aware of these values. So in the present chapter we will discuss about the biodiversity, its conservation and the values one should learn from biodiversity.

1.7.2 Biodiversity

Biodiversity refers to all living forms –all plants, animals and micro-organisms including their cultivated and domesticated generation species. Biodiversity is somewhat at higher level than the wild life. Biodiversity is not just the number and accumulation of species but a conglomeration of interdependent diverse species all of whom need to be conserved in juxtaposition in their respective natural ecosystem. In 1986 Walter G.Rason has used this term biodiversity for plants, living organisms, micro-organisms and their types and the differentiation between them.

According to the US office of Technology Assessment (1987), biological diversity is, “the variety and variability among living organisms and the ecological complexes

in which they occur." Biodiversity is the variability among living organisms from all sources including inter-alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between special and of ecosystem.

1.7.2.1 Levels of Biodiversity

All living forms differ from each other in small or large variations. These variations are recognized at 3 levels given below:

(i) **Genetic Level :** These are the variations which exist in all living forms, because of different gene combinations since birth e.g. two sisters or brothers of the same parent differ from each other in terms of their general appearance, height, intelligence, habits, etc.

(ii) **Species Level :** We all know that all organisms differ from each other, because they belong to different species e.g. cat, dog, lion, fish, frog, or the plants of maize, rice, barley, mango, wheat or the micro-organisms like bacteria, viruses, protozoa, etc. They all differ from one another.

(iii) **Ecosystem Level :** All living beings show variations in their habitats, habits, and other ecological system e.g. fish, frog, snakes, birds and mammals living in different environment differ from each other. Similarly, ecosystems of forests, deserts, grasslands, fresh water rivers or marine habitat differ from one another.

The term ' Biodiversity' gained circulation after the UN convention at Rio-de Janeiro in 1992. To give expression to the tenets of the convention; the ministry of environment and forests has obtained funding for preparing the National Biodiversity Strategy and Action Plan (NBSAP). The most significant manifestation of the NBSAP has been the 'Biological Diversity Bill'. The proposed legislation defines biological diversity as the variability among living organisms from all sources and the ecological complexes of which they are part and includes diversity within species or between species and ecosystems. Not very lucid not very comprehensive, but it conveys the broad implications of Biodiversity.

Biodiversity includes wild species of fauna and flora including micro-organisms and the natural ecosystems that they depend upon and the vice-versa. It also include domesticated species of animals and plants, indigenous cultivators and agricultural ecosystems.

1.7.3 Values of Biodiversity

Since the dawn of human civilization, it has depended on the biodiversity around man. In the earlier times biodiversity has provided food, fodder, fuel and fabric needed to the earlier hunters, food gatherer society and agricultural society. In the modern technological and industrial society too, it is sustained by the biodiversity for providing medicines and raw materials besides providing food, fodder, fuel and fabric. In respect of the use of these resources the value of biodiversity is divided into following six categories:

1. Consumptive Value of Biodiversity
2. Productive Value of Biodiversity
3. Social Value of Biodiversity
4. Ethical Value of Biodiversity
5. Aesthetic Value of Biodiversity
6. Other Value of Biodiversity

1.7.3.1 Productive Value of Biodiversity

The productive use of Biodiversity is in the form of exchange of products in the International market, which enhances the national income. Biodiversity provides us many products, such as fuel (coal, oil), timber, fish, fodder, leather (skin), fruits (dry & fresh), fibers, cereals, spices and medicinal plants, etc. All these provide near about 30% of the total income of the Country.

1.7.3.2 Consumptive Value of Biodiversity

In which natural products are used directly such as grass and cane.

1.7.3.3 Social Value of Biodiversity

Biodiversity plays an important role in social milieu and culture. Several plants and animals are worshipped and protected, some of the important plants are Mahua, Kadamb, Palash, Kela, Peepal, Bargad, Amla, Shami, Tulsi, Khejari, Ashoka etc. Similarly some of the animals worshipped at different occasions are elephant, monkey, cow, lion, snake, etc. Plants and animals are also associated with various other social and religious activities.

1.7.3.4 Ethical Value of Biodiversity

We have evolutionary responsibility to conserve biological diversity for our

descendants. A species becoming extinct is lost permanently. It would be unethical to let a species disappear in our life time. Every species has a right to live and propagate in this bio world and share the available resources. In fact many religious preaches worship of animals and plants.

1.7.3.5 Aesthetic Value of Biodiversity

Biodiversity is a source of inspiration to poets and artists to compose poems and songs and to make paintings and sculptures. Many animals have contributed to idioms, proverbs and poems. Biodiversity of India is a cultural asset for our Country and influenced our art, sculpture, literature and religion to a great extent.

1.7.3.6 Other Values of Biodiversity

Biodiversity is of great significance because it deals with the functions of ecosystem such as ecological balance, conservation of natural resources, prevention of soil erosion and inspite of this it has scientific values, recreational and sports values etc.

1.7.4 Threats to Biodiversity

Human activity is the major threat to biodiversity. Excessive and uncontrolled biotic interference is one of the major threats. This interference results in quantitative and qualitative changes in India's biodiversity. Pink headed ducks, cheetah, quail are among the already extinct species. Over 150 plants are under endangered category.

The threat to biodiversity can be divided into two categories.

1. Natural Threats
2. Artificial Threats

1. Natural Threats to Biodiversity: Following are the chief natural threats to biodiversity.

(a) Drought : When the land becomes dry and its water contents reach below 20% to 25%, this loss of water leads to the condition of dryness which is called as drought. In this condition the soil becomes infertile and unable to grow plants. So in the absence of vegetation, animals don't get food – as a result they shift from drought area to another area and this leads to loss of biodiversity.

(b) Land Slides : Land slides occur usually in hilly areas. Sometimes the whole hill slides down and various residential areas are also affected by it. So in hilly areas landslides are the major threats to biodiversity.

(c) Diseases : Various diseases which are spread by spores and flies can easily spread in the region. Some of these are very lethal and engulf the field very quickly. Various communicable diseases like Dengu and Swine flu might become lethal if not properly cured.

(d) Floods : Floods are the result of heavy rainfall in the upper region of hills. Due to continuous and heavy rainfall, the water level in rivers and streams rises and starts overflowing. This overflowing water breaks riverbanks and rushes to nearby fields and areas and converts into floods. As a result due to the floods sometimes soil erosion occurs and land becomes unuseable for vegetation etc. This leads to scarcity of food and habitat loss.

(e) Competition with other Species : Competition between species sometimes leads to loss of one species as the law of survival of the fittest prevails.

(f) Storms : Storm occurs when the wind blows with very high speed and thrash away everything with it. The residential areas and vegetation destroyed by storm and superficial fertile layer of soil gets eroded. Due to this, various species of plants and animals loss their habitat.

(g) Natural fires are also responsible for destruction of ecosystem.

2. Artificial Threats to Biodiversity:

Artificial threats or man induced threats to biodiversity are as follows:

(a) Deforestation : It is the major threat to biodiversity. Man exploited forests for his own luxuries causing imbalance in the ecosystem. As we know that the basic needs of man are fulfilled by forests but this should not be done at the cost of biodiversity. Deforestation mainly causes habitat destruction leading to extinction of many species of flora and fauna.

(b) Urbanization : Expansion of urban areas due to population explosion leads to cutting of trees for building houses & other purposes leads to loss of habitat of natural animals and birds.

(c) Industrialization : Industrial development although increase the economy of the country but basic raw material of these are obtained by forests &

ultimately growing industries for fulfilling their requirements started exploiting the forests. The another bad aspect of industrialization is that the chemical industry synthesize such new organic chemical products which have been introduced in environment by one or another way and ultimately affects the ecosystem.

(d) Scientific & Educational Research: Scientific and research scholars use the animals and birds for their research purposes which leads to death of various animals and birds.

(e) Construction of New Buildings, Dams &Roads also destroy the habitat of flora and fauna.

(f) Use of Chemical Fertilizers: The excessive use of chemical fertilizers & pesticides ruin certain species of plants as well as animals.

(g) Over exploitation of selected.

(h) Accidental or deliberate introduction of exotic species.

(i) Wars and Battles : Explosives, shells and gun fires heavily destroy the vegetation and this leads to loss of flora and fauna.

(j) Impact of Tourism : Most pronounced destruction due to tourism is observed in the wildlife part. Biodiversity is being seriously damaged due to tourists activities.

(k) Global warming, green house effect and ozone layer depletion have deleterious effect on species on the earth.

(l) Poaching of Wild Life : Poaching is the illegal taking of wild plants or animals contrary to local and international conservation and wildlife management laws. Violations of hunting laws and regulations are normally punishable by law and collectively, such violations are known as poaching.

Habitat loss

A **habitat** is the natural place where plants, animals, or other organisms live; it is where they call home. This is the living area necessary for an ecosystem to remain healthy. **Destruction** means to change something so much that it can no longer exist as it once was. So, when we put the two definitions together we get habitat + destruction = a home to species that has been changed to the point it no longer exists.

Habitat destruction occurs when enough change has happened to an area that it can no longer support the natural wildlife. This change can actually be in many forms, including destruction, fragmentation, and degradation. But no matter how it happens, the plants, animals, and other organisms whose habitat has been destroyed no longer have a home.

Most endangered species are threatened by multiple factors, but habitat loss is generally viewed as the largest single cause of biodiversity loss worldwide. When humans convert wild areas for agriculture, forestry, urban development, or water projects (including dams, hydropower, and irrigation), they reduce or eliminate its usefulness as a habitat for the other species that live there.

The activities that lead to habitat loss are

* Forest loss and degradation due to expansion of land
* Intensive harvesting of timber for fuel and other products
* Over grazing
* Increasing food production

Poaching of Wildlife :

Poaching has been traditionally defined as illegal hunting, killing or capturing of wild animals. Animal poaching is when animal is killed illegally to use its For or ivory for making different products or for medicinal purposes.

Reasons for Poaching

Humans and their ancestors have hunted for over 400,000 years. Historically, hunting has played an important role in leadership, community formation, language development, and tool use. While primitive humans relied largely upon hunting for food, the agricultural revolution (approximately 10,000 years ago) reduced the need for survival hunting in most parts of the world. Hunting has continued, however, for several reasons, and poaching remains a possibility wherever hunting is an important part of the economy or culture. Animal products, such as hide, ivory, horn, teeth and bone, are sold to dealers who make clothes, jewelry and other materials from them. In some African and Latin American societies, animals are poached for game meat. In Congo, for example, monkey meat is sold in the open market, and in North America, white-tailed deer is hunted for food.

Some animals have religious value and are used as totems and in witccraft. For example, among the Banyoro, Baganda and Batooro of West and Central Uganda, the king traditionally sits on a leopard skin. Many tribes in Congo consider leopard skin a symbol of magic, and many witch doctors in the region use these skins to show their powers. Many animals are killed for ceremonial purposes, such as cleansing a bad omen, asking gods for rain, etc. Major wildlife crime in India includes poaching of tigers, rhinos and the sale of Star tortoises. Tigers are an endanegered species, poached for their skin and bones to cater to an illegal market. Their body parts are used in Asian medicines and tiger claws are used in jewellery. Tiger whiskers are considered a dreadful poison in Malaysia and a powerful aphrodisiac in Indonesia.

Ancient trade routes for salt, spices and wool are being used to smuggle tiger skins and bones. These illegal goods are sent to buyers based largely in northern India and are then smuggled out of the country through couriers. The main route is via Nepal, with whom India has a porous border, or directly across the border to China. More recently, routes through Myanmar have also been used.

Apart from tigers, India is also witnessing a rise in wildlife crime against Rhinoceros.

Animals are also believed to be a source of local herbs and have medicinal value. For example, it is believed by some Lendu in Eastern Congo that the lion's liver cures skin diseases, and it is also used as a poison. Mbuti pygmies of Western Uganda and Eastern Congo are said to use snake poison on their fighting arrows. Animals in the developing world are also hunted as vermin by communities that leave near forests and game parks. The aim is to kill the animals and stop them from encroaching on farms.

Hunting for sport is also practiced in various nations. Though most of it is controlled, illegal sport hunting is common in developing countries. Many sport hunters keep the animals as trophies.

No matter the reason why an animal is killed, all types of hunting or poaching have led to extinction of species, and if uncontrolled many more animals will become extinct.

Preventing poaching

We should be aware of poachers and should prevent poaching. We should

help **IUNC** for protecting animals, award stringent punishment to guilty. Increase security around forests, national parks, biosphere reserves, etc. If we will follow these steps, we will be able to protect animals from extinct, endangered and disappear from Earth.

Man-wildlife conflicts

Man-animal conflicts are common in various parts of the country. Incidents of man-animal conflict are reported from States/Union Territories of the country. In India, wild elephants probably kill far more people than tiger, leopard or lion. But, surprisingly, human conflict involving leopard draws great amount of public attention compared to other animals. Other carnivores - tigers, lions and wolves which have been known for causing a large number of human deaths in the past, are now mostly restricted in range and their impact is not as widespread as that of the leopard. The Government is giving highest priroity to mitigate the problem. It supplements the financial resources available with the States/Union Territory Governments for the purpose by providing limited funds under the Centrally Sponsored Schemes of 'Project Tiger', 'Project Elephant' and 'Integrated Development of Wildlife Habitats'. Payment of *ex-gratia* to the victims of wild animals is the responsibility of the concerned State/Union Territory Governments. Animals like elephant, tiger, leopard, wild dog, monkey, wild boar; Nilgai, bear, sambar deer etc. are major animals involved in human-animal conflict in India.

Reasons of man-wildlife confict.

Major reasons of conflict are :

* Deforestation
* Loss of Habitat
* Decline in Prey
* Injured or Old Animal
* Growing Human Population

In India, man-animal conflict is seen across the country in a variety of forms, including monkey menace in the urban areas, crop raiding by ungulates and wild pigs, depredation by elephants, and cattle and human killing by tigers and leopards.

Damage to agricultural crops and property, killing of livestock and human beings are some of the worst forms of man-animal conflict.

The increase in man-animal conflict is likely due to the greater resilience and adaptability of wild animals in face of their shrinking habitats, which allow them to live successfully close to human habitation.

Degradation of habitats, depletion of the natural prey base, changing crop patterns, suitability of man modified habitats to wild animals, presence of stray dogs and cattle in forest frings areas etc are other reasons. Crops like sugarcane and tea estates are reported to provide excellent cover for wild animals.

1.7.5 Conservation of Biodiversity

Conservation means the management of man's use of biosphere in such a way that it may provide the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspiration of future generations.

The need to save the biodiversity is of utmost importance. Every domesticated animal or cultivated crop plant has been evolved from their wild parent type. In case these become extinct the whole evolutionary tree will be disturbed. In order to maintain over all life supporting systems, maintenance of all wild species and their ecosystems is highly essential. Biodiversity in general can be conserved in two ways.

1.7.5.1 In-situ Conservation of Biodiversity: It is the most ideal form of biodiversity conservation. In this all species are preserved in their natural habitat. All species, their genes and habitats are interlinked.

(1) Indian Government for conserving wild life has many multi pronged programmes, creations and management such as management of national parks, wild life sanctuaries and biosphere reserves. In these all species are conserved within their natural habitat. In these reserve areas are divided into zones like core and buffer zones.

(2) In core education, tourism, sustainable agricultural practices and locally beneficial and ecologically sound developments are carried.

(3) National wild life action Plan has been chalked out.

(4) The 42nd Constitutional Amendment in 1976 moved wild life from "State list of the constitution to the concurrent list."

(5) The central legislation deals not only with hunting, but also with the set up of National Parks, wild life sanctuaries and control of trade in wild life products.

(6) The habitats of wild animals from further damages have been prohibited.

(7) A Central Zoo Authority has been set up to oversee the functioning of all zoos.

(8) The wild life should be protected in national habitats (in situ) as well as in artificial habitats like zoological parks and botanical gardens (ex situ) under human control.

(9) A sound planning and management of land and water uses is required for prevention of the process of extinction.

1.7.5.2 Ex-situ Conservation of Biodiversity: In this all threatened, endangered or rare species are preserved in most appropriate areas outside their natural habitat for their conservation.

(1) It is done only when the survival of very few species left became impossible in their wild state. Such species of plants, animals or micro-organisms are carefully conserved and propagated in botanical gardens and zoological parks and zoological gardens, research centers, aquaria, etc. These methods not only help in their conservation but also help in their study sites and for raising public awareness on conservation issues.

(2) Gene banks, research laboratories and in-vitro storage are some of the common methods used in these for their conservation. Once these species number is sufficiently restored they are reintroduced back into their natural wild habitat.

(3) Planning long term and short term plans for conservation.

(4) Took bold and strong steps against the intruders and exploiters of biodiversity.

1.7.6 Summary

Biodiversity is all plants, living organisms, micro-organisms and their types and the differentiation between them. It has three levels (i) Genetic, (ii) Specific and (iii) Ecosystem level. Biodiversity is beneficial to mankind in different ways as

(1) Productive use, (2) Consumption use, (3) Social use, (4) Aesthetic use, (5)

Ethical use and (6) many other uses.

There are various Natural and artificial threats to biodiversity due to which extinction of species takes place. In general biodiversity can be conserved in two ways: (i) In-Situ Conservation and (2) Ex-situ Conservation.

1.7.7 Glossary (Key Concepts)

1.	Deforestation	:	Cutting or felling of trees or forest cover.
2.	Aesthetic	:	Pertaining to beauty.
3.	Ozone	:	gas made of oxygen atoms (O_3)
4.	Biodiversity	:	It is the variability among living organism from all sources including inter-alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.
5.	In-Situ Conservation	:	It is the conservation of ecosystems and natural habitats and recovery of viable population of species in their natural surroundings.
6.	Ex-Situ Conservation	:	The conservation of components of biological diversity outside their natural surrounding i.e. zoo, sanctuaries and botanical gardens, zoological parks etc.

1.7.8 Self-Check Exercise

Fill in the blanks:

1. There are ..... levels of biodiversity.
2. Many religion preaches worship of ..... and .....
3. The threat to biodiversity can be mainly divided into.....categories.
4. Drought is a ..... type threat to biodiversity.
5. Artificial threats are ....., ..., ..., ..., etc.
6. Biodiversity in general can be conserved in ..... ways.
7. Preservation of species in their natural habitat is known as ..... conservation.

8. Preservation of species outside their natural habitat is known as ..... conservation.

Answers: 1. Three 2. Animals, plants 3. Two, 4. Natural

5. Deforestation, urbanization, industrialization, tourism, etc.

6. Two 7. In-Situ 8. Ex-Situ

1.7.9 Suggested Questions

1. What is Biodiversity? Describe various types of biodiversity.
2. Explain the threats to biodiversity.

1.7.10 Suggested Readings and Web Sources

1. Environment Studies : R.R. Das
2. Environmental Education : R.A. Sharma
3. Basics of Environmental Education : Rajinder Kaur & Paramvir Singh
4. Environmental Education : R.C. Sharma & Gurbir Singh

Web Sources:

1. edugreen.teri.res.in
2. en.wikipedia.org
3. books.google.co.in

Lesson No. 1.8 Author: Amita Kaistha

Biodiversity (II)

Structure:

1.8.0 Objectives

After going through this lesson, students will be able to

1. Explain biodiversity at global, national and local level.
2. Discuss biogeographical classification of India.
3. Define Hot spots of Biodiversity.
4. Distinguish between endangered and endemic species.

1.8.1 Introduction

As popular interest in protecting the world's plants and animals species intensified during the last 30 years, both scientists and general public have realised that we are living in a time of unprecedented mass extinction. The main cause of this extinction is habitat's destruction by man, such as cutting of trees, overgrazing grasslands, draining wetlands and polluting the ecosystem. Overharvesting of plants and animals by modern technology is the major cause of extinction. Conservation biology is new multidisciplinary science that has developed to deal with the crisis confronting biological diversity. A biodiversity is a biogeographic region, which is a significant reservoir of biodiversity, which is threatened with destruction. Biological communities that took millions of years to develop are being devastated by human activities around the globe. Conservation biology is new multidisciplinary science that has developed to deal with the crisis confronting biological diversity. It has two goals –first, to investigate human impacts on biological diversity and second, to develop practical approaches to prevent extinction of species.

1.8.2 Biodiversity at Global, National and Local level

Biodiversity is the variability among living organisms from all sources including inter-alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystem. It is thus the totally of genes, species and ecosystem in the region.

Overall diversity of any given area depends upon the range of habitats it includes and the diversity of the component habitats and are ranked as follows.

1. **Alpha Diversity :** Diversity within a site or habitat. This may be local level biodiversity.
2. **Beta Diversity:** Differences of diversity between habitats. This may be called as national level diversity.
3. **Gamma Diversity:** Differences in site diversity over a large area such as a continent.

1.8.3 Biogeographical Classification of India

Biogeography deals with the geographical distribution of plants and animals. Situated at the confluence of Agro-tropical, Euro-Asian and Indo-Malayan

biogeographic realms. India exhibits a vast biodiversity due to inclusion elements of all the three biogeographic realms. This has also been possible due to presence of a wide range of varieties of habitats and climatic conditions. India is one of the eight 'Vavilov Centres' of high crop genetic diversity and is characterised by having a high proportion of endemic species in its vegetation. Amongst animals amphibians have maximum percentage of endemic species.

1.8.3.1 Floristic Regions of India

Botanical Survey of India (Anonymous, 1991) has divided India in following nine biogeographical regions based on floral diversity:

1. **North-western Himalaya:** Its outer ranges covered by subtropical dry evergreen, subtropical pine forests and moist temperature zone forests and inner range have dry temperate forests, and moist and dry alpine scrubs.

2. **Eastern Himalayas:** These are wetter and warmer, and are more rich in biodiversity.

3. **Western Arid Region :** Characterized by sparse vegetation or fairly distinct four habitat conditions namely:

(i) Sandy plains and dunes

(ii) Gravelly plains

(iii) Rocky habitats and

(iv) Saline depressions

4. **Genetic Plains :** Stretching from eastern Rajasthan through Uttar Pradesh to Bihar and Bengal. The whole area is chiefly under agriculture. Natural vegetation consists of tropical moist deciduous forests and tropical dry deciduous forests.

5. **Eastern India :** Includes plain regions of Arunachal Pradesh and other six eastern states. Vegetation consists of Tropical wet evergreen forests of eastern and Southern Assam, tropical moist deciduous forests of Meghalaya, Tripura and Mizoram, Sub-tropical pine forests of higher elevations in Meghalaya, Manipur and Nagaland having endemic insectivorous pither plant. This region represents high diversity of orchids, bamboos, tree ferns, aroids and members of Zingiberaceae.

6. **The Deccan Plateau :** Area lies south of Vindhyan hills and eastern and western Ghats. Major part of the area is covered by tropical thorn forests, tropical dry deciduous forests.

7. **Western Ghats :** It has tropical moist deciduous forests, tropical semi-evergreen forests, tropical wet-evergreen forests. Nilgiris have subtropical broad leaved hill forest species.

8. **Eastern Ghats :** The area holds tropical dry deciduous or thorn forests. A small northern area bordering Orissa possessesmoist deciduous forests. "Sholas" are dominated by evergreen species.

9. **Andaman and Nicobar Islands :** The Islands have rich biodiveristy having tropical wet evergreen, semi-evergreen and moist deciduous forests.

1.8.3.2 Faunal Regions of India

The forests and wild life Department, Government of India has identified ten biogeographical zones of India with respect to faunal diversity (anonymous 1993).

1. **Trans-Himalaya :** Ladakh (Jammu and Kashmir) and Lahol-Spiti (Himachal Pradesh) area has several endemic species as Tibetan Ass, wild yak, pallas Cat, pika and marmot.

2. **Himalaya (North-west, Western, Central Eastern):** It is the richest area of species and habitat diversity. It has largest number of endangered species than any other region of the Country.

3. **Desert (Kutch-Gujrat, Thar-Rajasthan):** It is the only breeding place for flamingoes in India. Important animals are wild ass, desert cat, desert fox, great Indian bustard.

4. **Semi-Arid (Punjab, Gujarat, Rajasthan):** It has two tiger reserves in Sariska and Ranthambhor National Parks. Gir lion is an endemic species.

5. **Western Ghats (Coastal plain and mountains of Maharashtra, Kerala and Karnataka):** It is the richest and ever existing genetic storehouse having about 1800 endemic species.

6. **Deccan Peninsula:** (Deccan plateau south, Central plateau, North Eastern plateau, Chotanagpur, Central highlands) It constitutes about 43% of India's total land area. This area has luxuriant wildlife.

7. **Gangetic Plain:** (Upper and Lower Gangetic Plain) The most fertile area of the world. It has now relict wildlife as the area has been under cultivation for sanctuaries.

8. **Marine Coasts (West coast, East coast):** It comprise of biologically rich mangrove vegetation. It has marine and estuarine plants and animals. Sundarban Sanctuary is a tiger reserve having highest population of tigers in India.

9. **North-east (Brahmaputra Valley, Assam hills):** It is supposed to be the biogeographic gateway for most of India's flora and fauna.

10. **Indian Islands (Andaman, Nicobar and Lakshadweep Islands):** A group of 348 islands have immensely rich biodiversity. It has about 225 distinct faunal species of which 112 are endemic.

1.8.4 India as a Mega Diversity Nation

Warm and humid regions lying within the tropic of Cancer and tropic of Capricorn are endowed with rich and diverse plant, animal and microbial life. More than half of the total number of species present on earth occur in this belt. India has very rich diversity of wild plants and animals and is considered to be one of the mega-diversity nations. Its share of the global diversity is about 8.6% of the wild plant and animal species. Mittermeir and Werner (1990) using the criteria of species richness, introduced the concept of Mega-diversity centres. Totally there are 34 mega-diversity centres in the world.

India is 10th among the plant and animal rich countries of the world and fourth among the Asian Countries. Out of the 34 'Hot Spots' identified in the world, India has four. These are Eastern Himalayas, North East India, Western Ghats and Andeman & Nicobar Islands. The crops which first grew in India are spread throughout the world include rice, jute, sugarcane, mango, citrus, banana, several species of millets, medicinal, aromatics & ornamentals. India ranks 6th among the centres of biodiversity and origin in terms of agro-biodiversity.

1.8.4.1 Hot Spots of Biodiversity

To qualify as a biodiversity hotspot, a region must meet two strict criteria; it must contain at least 1,500 species of vascular plants as endemics, and it has to have lost at least 70% of its original habitat: Around the world 34 areas qualify this above said criteria. These sites support nearly 60% of the

world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species. These sites are called 'Biodiversity Hotspots'. Hotspots are the areas that are severely threatened by human activities. At the same time they contain outstanding examples of evolutionary processes of speciation and extinction. All those areas that support rich biodiversity, endemic flora and fauna, and exhibit exceptional scientific interest are called as hot spots. Most of the world's biodiversity concentrations are near the equator, especially tropical rain forests and coral reefs.

1.8.5 Endangered Species

Endangered species are those species (or taxa) whose number have been adversely affected to a level that poses immediate danger to their extinction. There is no surety of their survival if the causative factors of extinction continue to operate. It is considered that about 81 species of mammals, 38 species of birds, and 18 species of amphibians and reptiles are endangered in India. These include lion-tailed Macaque *(Macaca silenus)*, Nilgiri langur, clouded leopard, snow leopard, Asian elephant, peacock, tiger, Kashmiri stag, and one-horned rhinoceros, etc.

1.8.6 Endemic Species

Endemic species can be defined as those species, which are confined to a particular locality. Such organisms are very important from the point of view of conservation. Endemism represents from the point of view of conservation. Endemism represents a unique process of evolution, which could be perpetuated and sustained only in the locality concerned. The importance of the habitat is highlighted by the fact that in most of the cases such localities possess a number of endemic species distributed in several groups. It is reported that 33% of flowering plants recorded are endemic to our country. Besides that out of recorded 53% fresh water fishes, 60% amphibians, 36% reptiles and 10% mammals are endemic to India.

1.8.7 Summary

Biodiversity is closely related to the function and stability of communities and ecosystems. Biodiversity being a broad concept, a variety of objective measures have been created in order to measure biodiversity empirically. Biodiversity is the totality of genes, species and ecosystem in the region. Depending upon the range of habitat it is of three types- 1. Alpha diversity,

2. Beta diversity, and 3. Gamma diversity. Floristic Biogeographical regions of India are nine in numbers. (i) North-West Himalayas, (ii) Eastern Himalayas, (iii) Western arid region, (iv) Gangetic Plains, (v) Eastern India, (vi) The Deccan plateau, (vii) Western Ghats, (viii) Eastern Ghats, (ix) Andaman Nicobar Islands, and there are ten faunal biogeographical regions in India, these are: (i) Trans-Himalaya, (ii) Himalaya, (iii) Desert, (iv) Semi-arid, (v) Western Ghats, (vi) Deccan Peninsula, (vii) Gangetic Plain, (viii) Marine Coasts, (ix) North-East, (x) Indian Islands. India has very rich diversity of wild plants and animals and is considered to be one of the mega diversity nations. India is one among the mega diversity nations which has four hot spot. Hotspots are the sites that are severely threatened by human activities.

In this chapter we have also discussed endangered species and endemic species. Endangered species are those whose population have greatly reduced and survival to a level that posses immediate danger to extinction. Endemic species are those which are confined to a particular locality.

1.8.8 Key Concepts

1.	Biodiversity	:	Variation of life at all levels of biological organization.
2.	Endemism	:	It represents a unique process of evolution, which could be perpetuated and sustained only in the locality concerned.
3.	Endangered species	:	Whose population poses immediate danger to extinction.
4.	Endemic Species	:	These are those which are confined to a particular locality.

1.8.9 Suggested Readings and Web Sources

1.	Text book of Environmental Studies	-	Dr. K. Raghavan Nambiar
2.	Environmental Studies	-	R.R. Dass
3.	Environmental Studies	-	R. Rajagopalam
4.	Environmental Education	-	R.A. Sharma

Web Sources:

1. www.globalissues.org
2. edugreen.teri.res.in
3. en.wikipedia.org

1.8.10 Suggested Questions

1. What are the biogeographical regions of India?
2. Discuss India as Mega-Diversity Nation.
3. Enumerate the measuring scales of biodiversity.

1.8.11 Self Check Exercise

Fill in the blanks:

1. There are ..... levels of bio-diversity.
2. Measuring scale of biodiversity are of ..... types.
3. Botanical survey of India (1991) has given ..... floristic regions of India.
4. Forest and wild life department, Government of India has identified ..... regions of faunal diversity.
5. Out of 34 world's biodiversity hotspots there are ..... in India.
6. One-horned Rhinoceros is an example of ..... species.
7. Niligiri Langur is an example of ..... species.
8. In India ..... percent of flouring plants are endemic.

Answers:	1. three	2. three	3. nine	4. ten
	5. four	6. endangered	7. endangered	8. 33%

Lesson No. 1.9 **Author : Ms. Ravneet Kaur**

ENVIRONMENTAL POLLUTION

1.9.0 Objectives

The scope of this lesson is to familiarise you with the basics of environment pollution. After studying this lesson, you will be able to understand :

- What is Environmental Pollution?
- Causes, effects and control measures of : air, water, soil, marine, noise, thermal pollutions, nuclear hazards, and solid waste management

1.9.1 Introduction

Only after the last tree has been cut down,

Only after the last river has been poisoned,

Only after the last fish has been caught,

Only then you will find that money cannot be eaten.

- Native American Prophecy

Although we do have the whole world at our finger tips in this global village but we have global environmental pollution also in the age of internet. Development on our planet has taken place at the expense of environment and we can reasonably say, the more the development, the more the environmental pollution. The rise and rise of various pollutions at the local and global levels has led to the pollution of the whole ecosystem. With the result that pollution has entered the food chain a long time ago, affecting not only human people but flaura & fauna also, leading to the extinction of many species and threatening the survival of the present ones, and yet humans are the sole preparations of the polluted natural environment. Be it in the name of urbanization, industrialization, advanced technology, trade, development etc. we do have polluted the nature.

What are the basic types of pollutions? What are their causes & effects and what measures can be undertaken to control and prevent environmental pollutions are discussed in this chapter.

1.9.2 Environmental Pollution

If you want to learn about the health of a population, look at the air they breathe, the water they drink, and the places where they live.

- Hippocrates

Some definitions

a) U/s. 2 of the Environment Protection Act, 1986

'Environment' includes water, air & land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;

'Environmental Pollutant' means any solid, liquid or gaseous substances present in such concentration as may be, or tend to be, injurious to environment;

'Environmental Pollution' means the presence in the environment of any environmental pollutant.

b) As per National Academy of Science, USA, Pollution is an undesirable change in physical, chemical or biological characteristics of air, water and soil that may harmfully affect man, animal and the plant life, industrial progress, living conditions and cultural assets.

Classification of Pollution : Pollution can be broadly classified into two categories :

I. According to different spheres of environment : Air, water and soil pollutions

II. According to different pollutants : Noise, industrial, thermal, nuclear etc. pollutions

Classification of Pollutants : Broadly in 2 types

I. On the form of their existence :

(a) Primary Pollutants : They exist in the environment as such after their release, like oxides of carbon, nitrogen, and sulphur; particulate matter (includes both solid particles and liquid suspensions) like soil particles, soot, lead etc.

(b) Secondary Pollutants : These are derived from primary pollutants i.e. produced in the atmosphere by chemical reactions, like sulphur trioxide (forms when sulphur dioxide reacts with oxygen) and sulphur trioxide combines with water to form sulphuric acid; or PAN (Peroxy Acetyl Nitrate) is formed by oxides of hydrocarbons and nitrogen reaction in sunlight, etc.

II. From ecosystem point of view :

(a) Bio-degradable Pollutants : These are degraded completely by micro-organisms, like domestic wastes, sewage, faeces, etc. and are absorbed by nature.

(b) Non-biodegradable Pollutants : These are not decomposed or degraded naturally as they are man-made, and moreover they accumulate over time and enter the food chain. Examples include, toxic metals, compounds, plastic, pesticides, DDT (Dichloro-diphenol-trichloroethane), PCBs (Poly chlorinated biphenyls) etc.

On the whole man's greed is interfering with nature and many environmental problems have arisen like depletion of ozone layer, global warming, imbalance of ecological system, extinction of species, health issues, biodiversity problems,

air, water and soil pollutions etc. And it is the high time that we should do something and help to control and prevent environmental pollution.

1.9.3 Air Pollution (Causes, effects and control measures)

Air pollution exists when there is a change in the composition of natural air, i.e. air contains presence of materials which are harmful to living beings and environment like harmful gases, solids or liquids in concentrations so as to affect humans, animals, birds, plants, other organisms, buildings etc.

Major Causes / Sources of Air Pollution

Broadly two categories, i.e. Natural causes and man-made causes.

I. Man made causes have proven more harmful than natural ones. These can be very broadly classified as outdoor and indoor sources of air pollution.

(a) **Outdoor Causes :** It means in the outside/open. These include gaseous emissions from industries, vehicles etc. Like coal burning for power generation, brick making, transportation industry, chemical, metal, non-metallic, crushing, cement, petrol refining, pesticides, mining, paper industries. Automobiles can be personal, public (bus, rail, air travel), fire crackers, tragedies (like Bhopal Gas) etc., waste burning in agricultural fields, pesticides, fly-ash, nuclear testing, wars, bio-fuels etc. are also major pollutants of air. And more population means more consumption and more pollution also.

(b) **Indoor causes :** It means inside buildings, closed area etc. These include mosquito coils & repellents, varnishes, paint, cooking, cigarette smoking, computers, color televisions, air conditioners, refrigerators, short-circuiting, micro-waves, heaters, x-rays in hospitals, etc. are major air pollutants.

Major effects of Air Pollution

1. More vehicles - more accidents, noise pollution, more carbon monoxide, more roads construction, cutting trees etc.
2. Lead in petrol - cause blindness, paralysis etc.
3. Smug - irritates eyes, respiratory illness etc.
4. Acid rain, ozone layer depletion, global warming etc.
5. Pesticides - cancer & other problems

6. Climatic changes - soil erosion, disasters, floods etc.
7. Increase in ultraviolet rays - skin rashes, cancer etc.
8. Cigarette smoking - heart problem, lung problems, etc.
9. More carbon monoxide - respiratory illness, cancer, TB, eyes irritation, nausea etc.
10. Indoor pollution - cold, influenza, depression etc.

Major Control Measures of Air Pollution

Implement and enforce environmental laws and standards strictly; reduce pollution at source; use lead free petrol (now lead in petrol is banned in India); use eco-friendly vehicles like 4-stroke bikes, e-bikes, e-cars; use CNG (Compressed Natural Gas) for diesel vehicles (Diesel automobiles banned in Delhi); use public transport; establish no smoking zones (smoking at public places is banned in Chandigarh, Delhi etc.); building green houses; stop burning of wastes; don't use fire-crackers; use CFL (Compact Fluorescent Lamps); observe Earth Day on 22 April; plant more trees; observe Car Free Day on 22 September (ban cars on this day and use only cycle or public transport); etc.

1.9.4 Water Pollution (Causes, effects and control measures)

Water is life. Without water we cannot survive. But now our major sources of water viz. ground water, surface water, rivers, oceans have become polluted by human greed.

Causes of Water Pollution :

Industrial chemical and other wastes, urban waste disposal, sewage, thermal pollution (hot water from industries), various industries viz. cement, textile, paper, leather, chemical, metal, pharma, fertilizers, etc., bio-medical wastes, mercury, arsenic, acids, zinc, copper, lead, chromium, selenium etc., agricultural wastes, pesticides, chemical compounds, mineral compounds, radioactive pollutants, various gases, DDT (even enters food chain), sediments (in severe soil erosion, much soil particles are carried by flowing water), micro-organisms (worms/parasites, bacterial, viruses from infected wastes), organic compounds (synthetic compounds with carbon), inorganic compounds (acids, salts, heavy metals etc.), and many more.

Effects of Water Pollution :

Destruction of water life (plants and animals), water borne diseases, unfit water for drinking and irrigation; foul smell from dirty water, scarcity of pure water, arsenic, mercury poisoning causes various health problems like kidney failure also, colour changing, hazardous micro-organisms like algae are harmful to like (skin, digestive, central nervous system problems etc.), birth defects, growth of harmful bacteria, paraties, viruses, etc.), DDT (affects central nervous system), cancer, heart, poisoning etc. and enters food chain and even harmful for plants and animals also apart from man) and many more.

Control Measures of Water Pollution :

Establishing proper sewerage and sanitation facilities; stop disposal of wastes in the flowing natural water; stop or reduce usage of pesticides; reverse osmosis; ultra-violet radiation; distillation method etc.; location of industries; treatment of industrial wastes like chemical coagulation, removal of by-products, chromium removal, oil & grease removal, etc.; various process like physical, chemical, biological processes; water softening processes, filtering, coagulation, aeration, chlorination; use of integrated pest management; growing vegetation on mining sites; and many more like implementing and launching various plans like Ganga Action Plan.

1.9.5 Soil Pollution (Causes, effects and control measures)

Soil pollution is much related to water pollution. Wherever in the soil any physical or chemical changes are present to affect the soil for growth of plants and other organisms which live on that soil, there is a case of soil pollution.

Causes :

Major cause of soil pollution is use of pesticides and fertilizers for agricultural purposes. They remain in soil and accumulate over time and also enter in the food chain, like DDT, PCBs, anti-termite solutions etc. Moreover, dumping of various wastes by humans is also responsible for soil pollution like garbage, sewage, radioactive pollutants, mining wastes, other industries wastes, plastic chemicals, metals, toxic substances etc.

Effects :

Salination of water and soil, harmful pesticides have adverse effects on all living

beings as they enter the food chain etc.; contaminated food production; soil becomes less fertile after much usage of pesticides thereby causing problem in food production leading to food scarcity. Even scientists have found that if there were no ants then we will have many problems on our planet, so every living being matters in the natural environment. Plastic remains intact and has various adverse effects. Soil erosion also takes place with soil pollution.

Control Measures :

Don't litter in the open; dispose wastes at designated places; clean surroundings; stop or reduce usage of fertilizers and pesticides; go for organic farming; DDT is banned in many countries; dilution (i.e. running fast water on soil to clean it, but disposal of water is a problem); vapour extraction (injection of air into soil so that some pollutants can evaporate); bio-remediation (introducing bacterial or other micro-organisms in soil); phyto-remediation (some plants roots absorb pollutants in their stems and leaves); ban polythene/plastic bags as done in many cities of India; prevent soil erosion by restoring forests, growing more plants, trees, grass etc.; use crop rotation and mixed cropping, and many more.

1.9.6 Marine Pollution (Causes, effects and control measures)

Oceans have become our ultimate dustbins. Marine pollution is the pollution of oceans by various human activities of discharging many toxic and hazardous substances into the seas which are harmful for sea life. It is interesting to note that there is much more flora and fauna in the oceans than on the earth. But the activities of humans are inhumane to the sea life.

Causes :

Oil discharges are major pollutants of marine pollution. Oil discharges by ships (washings, usage, bilge discharges etc.); toxic disposal of chemicals, plastics, pesticides; other hazardous solid materials; even ship material by accidents, nuclear accidents are also dumped in the oceans causing severe destruction of marine life; human wars disposal (gulf wars); oil fires etc.

Effects :

Oxygen reduction by oil; light penetration also reduces; smoothering (kills algae on sea shores); many types of flora and fauna are being destroyed in the seas; lethal toxity in sea life; severe effects on human life also like respiratory problems with crude oil, skin problems etc.

Control Measures :

Don't discharge hazardous wastes in the oceans; to control oil from seas there are various methods (skimming, chopped straw and chopped dust, chemical coagulation etc.); other processes like dispersion of oil, evaporation, emulsification, various absorbents, chemical additives etc.

1.9.7 Noise Pollution (Causes, effects and control measures);

Noise pollution is unwanted sounds which are heard by humans and even other species also and get disturbed by it.

Causes :

Power horns; unnecessary blowing of horns; vehicle engine noises like without silencer; loud music at various parties; machine noises at factories or industrial houses; noises at construction sites; noises at fire-crackers busting; even barking of dogs especially during night; noise by trains, buses, aeroplanes, police car sirens; listening at full volume on music players or watching TV at higher sound levels etc.

Effects :

Physiological, psychological, sociological etc; hearing loss when excessive loud music is played and listened to continuously over a long period of time, especially with ear/head phones; creates nuisance; leads to mental symptoms like disturbance of peace of mind, anxiety, violent behaviour etc., even loud music affects heart beating also; bursting of fire crackers disturbs birds and animals also like on Diwali night dogs become fearful and hide in various places, etc.

Control Measures :

Don't use fire crackers, don't listen loud music in open and on earphones also; don't use power horns; don't blow horn unnecessarily; use silencers in vehicles; silencers are also used on other machines in factories; use of curtains in homes to absorb noise; ban loudspeakers especially during exam times; use of sound absorbing materials; sound insulation; vibration control; use of ear plugs; grow more trees as they absorb noise also; etc.

1.9.8 Thermal Pollution (Cases, effects and control measures)

It refers to hazardous effects of heated effluents discharged by various power plants. Much heated liquid discharges are emitted and heated water leads to

pollution for all living beings and even pollutes air also.

Causes :

Nuclear power plants, coal fired power plants, industrial effluents (although less than power plants), domestic sewage also (heat in water causes release of foul smell and offensive gases in water); hydro electric power also causes thermal pollution; etc.

Effects :

Very adverse effects on all living beings including people, animals, birds, plants etc. Various problems come up with thermal pollution like reduction in dissolved oxygen, water properties got changed, toxity increases, reproductive powers of many animals especially fish and water animals got affected adversely, growth of blue-green algae etc.

Control Measures :

Cooling processes as done by cooling towers, creation of cooling ponds, artificial lakes etc., many preventive measures can also be undertaken like thermal plants should not be located near localities etc.

1.9.9 Nuclear Hazards (Causes, effects and control measures)

To go into war is easy but to sustain our environment is beyond our control especially if nuclears are used. These pose a great threat to our planet and even use of nuclear energy for electricity generation and use is not free from defects of polluting the environment.

Causes :

Various types of radiation is emitted by nuclears also. Even testing of nuclears causes a lot of pollution in the environment. And there have been many cases of nuclear accidents also where hazardous pollution has occurred. Even disposal of nuclear wastes has always remain a great problem as radioactive substances do not eliminate from the environment. So much care has to be taken to handle nuclear wastes.

Effects :

Nuclear testing pollutes air, water, soil, oceans and the whole planet also, affecting a large number of living organisms and flora & fauna alongwith human people. Like radioactive fallout (many radioactive particles are released in air); nuclear

reactors (gaseous and liquid pollutants are released); radiation from nuclear power plants (generate radioactive wastes); etc. There are many adverse effects of nuclear hazards like death, permanent crippling, skin problems, cancer, even DNA can be affected also, tumours, heart problems, birth defects, destruction of immune system; problems in reproduction etc.; even x-rays in medicine cause radiation problems so these should not be done unnecessarily.

Control Measures :

Some measures can be taken to protect our environment from nuclear hazards like, more nuclear testing should not be done, or it may be done underground but it has adverse effects also; nuclear reactions should be closely guarded and preventive measures be taken to prevent accidents; uranium, radium and other radio-active materials used for nuclear technology should be held with proper care and proper disposal of radioactive matters must be thought before releasing them; fission reactions should be minimized, nuclear medicine and therapy should be done with care; use of more solar energy should be stressed upon; have emergency tackling provisions in case of nuclear accidents; maintaining and implementing various guidelines and standards while handling, disposing etc. nuclear wastes as per the intensity of danger of the material should be done, etc.

1.9.10 Solid Waste Management (Causes, effects and control measures of urban and industrial wastes)

Solid waste is also sometimes referred to as Municipal Solid Wastes. It includes residential and commercial wastes and some industrial wastes also. Industrial wastes here refer to non-hazardous wastes only like paper. Solid waste management includes collecting, controlling, processing, utilizing or disposing of wastes as per available resources and policies.

Causes :

Large scale urbanization means more population, hence more wastes also. It includes garbage like thrown food, peels of various fruits or vegetables like - orange, banana, peas etc.; glass, glass bottles, plastic, cans like that of soft drinks or beer, belts, cloth, nylon, cotton, etc., cigarette butts, paper etc. And industrial solid wastes are mostly paper, cardboard, plastic, pins, packages etc. It includes some construction material also like empty bags of cement, debris etc.

Effects :

Pile up of garbage, foul smells, problems of flies, rats, mosquitoes, malaria, dengue, respiratory problems, infection etc.

Control Measures :

Cleaning the surroundings, don't litter in the open; litter at designated places only; don't waste food items; Re-use of products, recycling of materials (like plastic furniture, other items, paper, cardboard, newspapers, packages, aluminium recycling, glass recycling etc.); using wastes to produce energy like bio-gas; composting of yards like leaves and grass; various land filling techniques i.e. land should be used for solid wastes than throwing them in flowing waters; incineration; combustion etc.

Vermicomposting

Vermicomposting is the product or process of composing using various worms usually red wigglers, white worms and other earthworms to create heterogenous mixture of decomposting vegetables or food waste. It is high quality compost and is the best way of composting kitchen waste.

Vermicompost consists of worm casts plus some decayed organic matter. In ideal conditions worms can eat at least their own weight of organic matter in a day. They actually consume and derive their nutrition from all the microorganisms. One of the advantages of vermicomposting is that it does not contain disease pathogens because bacteria are killed in worms gut.

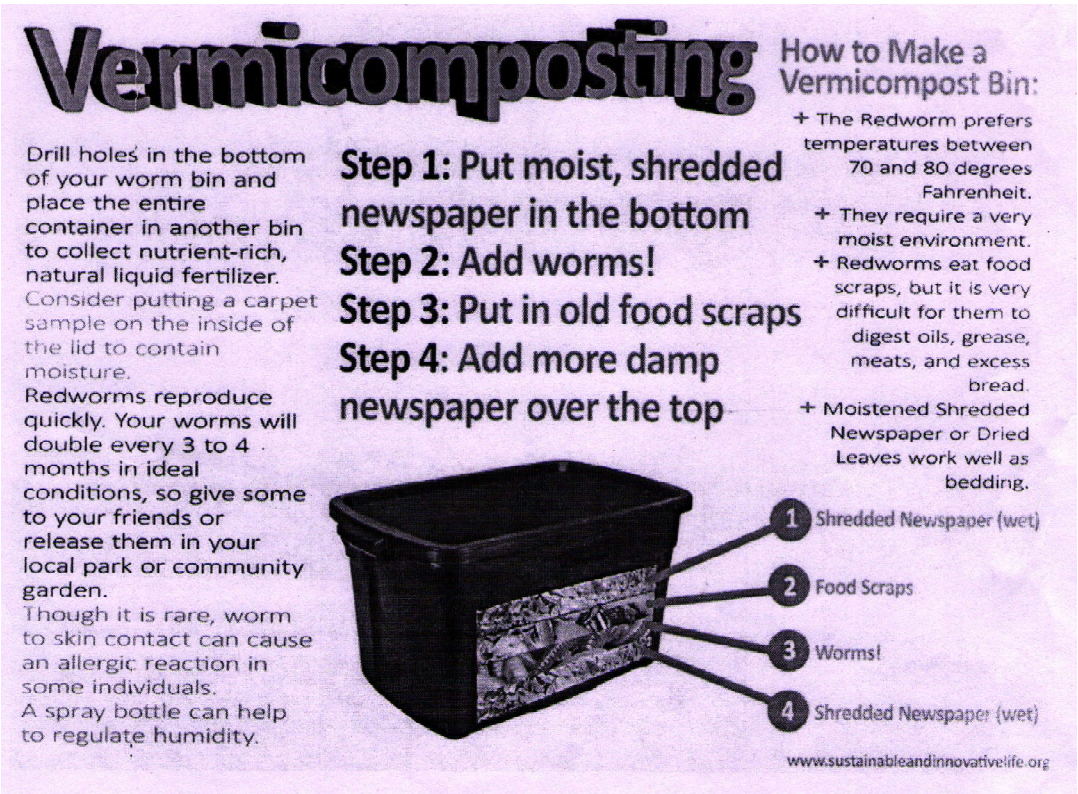
Worms contain five times more nitrogen, seven times more phosphorus and 11 times more potassium than ordinary soil. There casts are also rich in humic acids which contain the soil having perfect pH balance.

Two breeds of worms are generally used in vermicomposting :

* *Eisenia foetida* (red wigglers)
* *Lumbricus rubella* (red earthworms)

Nearly 1,000 worms are needed to start a worm box and twice if we want to process garden wastes. They breed very fast in right conditions.

Process of vermicomposting includes :



1. Selection of worm
2. Breeding which is done in worm boxes
3. Bedding
4. Feeding
5. Harvesting
6. Screening

Vermi-Composting

Nature has perfect solutions for managing the waste it creates, if left undisturbed. The biogeochemical cycles are designed to clear the waste material produced by animals and plants. We can mimic the same methods that are present in nature. All dead and dry leaves and twigs decompose and are broken down by organisms such as worms and insects, and is finally borken down by bacteria and fungi, to form a dark rich soil-like material-called compost. These organisms in the soil

use the organic material as food, which provides them with nutrients for their growth and activities. These nutrients are returned to the soil to be used again by trees and other plants. This process recycles nutrients in nature. This soil can be used as a manure for farms and gardens.

Steps for Vermi-Compost

* Dig a pit about half a meter square, one meter deep.
* Line it with straw or dried leaves and grass.
* Organize the disposal of organic waste into the pit as and when generated.
* Introduce a culture of worms that is now produced commercially.
* Ensure that the contents are covered with a sprinkling of dried leaves and soil everday.
* Water the pit once or twice a week to keep it moist.
* Turn over the contents of the pit ever 15 days.
* In about 45 days the waste will be decomposed by the action of the microorganisms.
* The soil derived is fertile and rich in nutrients.

1.9.11 Conclusion :

Urbanization has led to more environmental problems and is continuing to pollute the environment. Various types of pollutions have their own adverse effects on the whole planet ultimately. So environmental pollution must be prevented and controlled properly.

1.9.12 Glossary :

(i) **Element :** A basic form of matter, composed of atoms and cannot be sub-divided further. There are 92 natural elements like iron, gold, etc.

(ii) **Compound :** A chemical composed of more than one atom from two or more elements, like water (H_2O).

(iii) **Cigarette Smoke** contains carbon monoxide, nitrogen oxide (poisonous gases), and cyanide, benzene, ammonia, acetylene, formal dehydrate etc. (chemicals), tar (made of more than 4,000 chemicals) and much more.

(iv) **Smog :** Visibility is partially obscured by haze of solid particulars and liquid aerosols. Originate from London Smog in 1952 when it was caused by sulphurous. It is a mixture of smoke, fog and SO_2. It can cause death with pneumonia, bronchitis and other respiratory diseases.

(v) **Acid Rain :** In it, there is a presence of acids in the rain water. It consists of sulphur, nitrogen and chlorine emissions. It is caused due to human activities that are dangerous for the environment. It can cause various illnesses like respiratory, affects brain, digestive powers, etc. It affects plants, animals and buildings also and can damage marble as in the case of our Taj Mahal.

(vi) **Global Warming** is rise in average global temperature to such a level which affects life on our planet with increasing green house gases. Carbon dioxide is the largest contributor but CFCs and nitrous oxide are more powerful than it, and these are some others also like methane, halons etc. And the effects of increasing global surface temperature includes the problem of melting of glaciers.

(vii) **Kyoto Protocol :** In 1997 at Kyoto (Japan), it was held that industrialized countries should reduce emissions of some of the greenhouse gases by atleast 5 percent by 2012 and for some countries this percentage is more than 5 percent also. It is the commitment and logically binding international agreement to reduce greenhouse gas emission. However, developing countries are not legally bound by it but many such countries have ratified it including India. It is just a step to protect our environment.

(viii) **Ozone Layer** is an upper layer of atmosphere. It helps to protect various ultraviolet rays coming from sun by filtering these rays. As ultraviolet rays are very harmful for our planet. But when environment gets polluted by various chemicals then ozone hole develops and from it U-V rays reach earth. U-V rays can cause various skin problems like rashes, cancer of skin, lungs problems, eyes diseases etc. Hence ozone layer depletion is harmful for the whole earth.

1. Environment : Suroundings organisms at a given time and place
2. Pollutants : Any solid, liquid or gaseous substances present in such concentration as may be, or tend to be, injurious to environment.

1.9.13 Suggested Questions

(i) What is environmental pollution?

(ii) Discuss any five : air, water, soil, marine, nuclear, noise, thermal pollutions

(iii) What are solid wastes in urban areas? How they can be managed?

(iv) Explain any two : acid rain, smog, global warming, ozone layer, Kyoto protocol

1.9.14 Suggested Books

Suggested types of population ?

1. Text book of Environmental Studies - Dr. K. Raghavan Nambiar
2. Environmental Studies - R.R. Dass
3. Environmental Studies - R. Rajagopalam
4. Environmental Education - R.A. Sharma

Lesson No. 1.10 Author : Ashwani Kumar

Pollution - Prevention & Case Studies

1.10.1 WHAT IS POLLUTION?

Our lifestyles include cars, fast food, disposable items (for example, paper plates and plastic baggies), newspapers, air conditioning, household appliances (for example, microwaves and hairdryers), and many other items that make our lives safer, easier, and more comfortable. Unfortunately, pollution is often a consequence of producing, using, and disposing of these goods. Waste is unwanted or discarded material and when it is released to the environment, it becomes pollution. Pollution is generated by industries, agriculture, businesses, schools, vehicles, and even our homes and if not properly handled, can contaminate our soil, water, and air.

Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem i.e. physical systems or living organisms. Pollution is when water, air or land becomes very dirty. Pollution can come in four different types effecting different types of areas in the world. Air pollution affects the air, water pollution affects the water and marine life, land pollution affects the land destroying life and the environment. There is also noise pollution that can affect our hearing. We all contribute to pollution in one way or the other. Whether it is with a large amount or small

amount we can still cause major damage to our health and the environment. Although we all contribute to stop the increase of pollution. Very little people realize that pollution is very harmful because they don't think of the environment, themselves and other people and what it can do. Pollution is an important factor to our lives. It affects our society and all other animals. Pollution is gradually destroying our planet and is gradually killing ourselves too. Like air pollution, smog and acid rain are killers to all of us. It destroys marine life, our own health and destroys historical monuments and statues.

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. This occurs when only short term economic gains are made at the cost of long-term ecological benefits for humanity. During the last few decades we have contaminated our air, water and land on which life itself depends with a variety of waste products.

Pollutants include solid, liquid or gaseous substances present in greater than natural abundance, produced due to human activity, which have a detrimental effect on our environment. The nature and concentration of a pollutant determine the severity of its detrimental effects on human health. An average human requires about 12 kg of air each day, which is nearly 12-15 times greater than the amount of food we eat. So even a small concentration of pollutants in the air becomes more significant in comparison to similar levels present in food. Pollutants that enter water have the ability to spread to distance places, especially in the marine ecosystem. From ecological perspective, pollutants can be classified as follows:

Degradable or non-persistent pollutants: These can be rapidly broken down by natural processes e.g. domestic sewage, discarded vegetables etc.

Slowly-degradable or persistent pollutants: These are pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade e.g. DDT (pesticides) and most plastics.

Non-degradable pollutants: These can not be degraded by natural processes. Once the are released into the environment they are difficult to eradicate and continue to accumulate e.g. toxic elements like lead or mercury and nuclear wastes.

1.10.2 Causes, effects and control measures of pollution

There are different types of pollutions i.e. Air pollution, water pollution, Soil pollution, marine pollution, Noise pollution, Thermal pollution, Nuclear pollution etc. Now we will discuss their causes, effects and control measures in detail.

1.10.2.1 Air Pollution

The origin of air pollution on the earth can be traced back to the times when man started using firewood as a means of cooking and heating. With the discovery and increased use of coal, air pollution became more pronounced especially in urban areas. Air pollution began to increase in the beginning of the 20th century with the development of transportation systems and large scale use of petrol and diesel. Air pollution is a major problem affecting the entire world especially when we start burning forests which are the main source to oxygen (O_2). Air pollution is very harmful as it is destructive to living organs. The air is made of mainly oxygen and nitrogen but it also contains tiny amounts of other gasses such as carbon dioxide, hydrogen and helium. Most of it is nitrogen. We all contribute to air pollution in some way or another. Whether it is with a large amount or small amount we can still cause major damage to our health and the environment. Although we all contribute to stop the increase of air pollution.

1.10.2.1.1 The major types and sources of air pollution

All around the earth there is a thick blanket of air called the atmosphere. Air, like other gases, does not have a fixed shape. It spreads out to fill any available space so nothing is really empty. But air cannot escape from the atmosphere as the force of gravity protects it from floating away from the earth.

Air pollution is caused by any undesirable substance, which enters the atmosphere. Air pollution is a major problem in modern society. Even though air pollution is usually a greater problem in cities, pollutants contaminate air everywhere. These substances include various gases and tiny particles, or particulates that can harm human health and damage the environment. They may be gases, liquids, or solids. Many pollutants are given off into the air as a result of human behavior. Pollution occurs on different levels: personal, national, and global. Some pollutants come from natural sources.

The major types of air pollution are:

Gaseous pollutants: -

A different mix of vapors and gaseous air pollutants is found in outdoor and indoor environments. The most common gaseous pollutants are carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides and ozone. A number of sources produce these chemical compounds but the major man-made source is the burning of fossil fuel. Indoor air pollution is caused by cigarette smoking, the use of certain construction materials, cleaning products, and home furnishings. Outdoor gaseous pollutants come from volcanoes, fires, and industry, and in some areas may be substantial. The most commonly recognized type of air pollution is smog. Smog generally refers to a condition caused by the action of sunlight on exhaust gases from motor vehicles and factories.

Greenhouse effect : -

It prevents the sun's heat from rising out of the atmosphere and flowing back into space. This warms the earth's surface causing the green house effect. While a certain amount of green house gases in the atmosphere are necessary to make the earth warm, activities such as the burning of fossil fuels are creating a gaseous layer that is too dense to allow the heat to escape. Many scientists believe this is causing global warming. Other gases contributing to the problem include chlorofluorocarbons (CFC), methane, nitrous oxides, and ozone.

Acid rain : -

It forms when moisture in the air interacts with nitrogen oxide and sulfur dioxide released by factories, power plants, and motor vehicles that burn coal or oil. This interaction of gases with water vapor forms sulfuric acid and nitric acids. Eventually these chemicals fall to earth as precipitation, or acid rain. Acid rain pollutants may travel long distances, with winds carrying them thousands of miles before they fall as dew, drizzle, fog, snow or rain.

Damage to the ozone layer: **-**

It is primarily caused by the use of chlorofluorocarbons (CFCs). Ozone is a form of oxygen found in the earth's upper atmosphere. The thin layer of ozone molecules in the atmosphere absorb some of the sun's ultraviolet (UV) rays before it reaches the earth's surface, making life on earth possible. The depletion of ozone is causing higher levels of UV radiation on earth, endangering both plants and animals.

Particulate matter: -

It is the general term used for a mixture of solid particles and liquid droplets found in the air. Some particles are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with an electron microscope. When particulate matter is breathed in, it can irritate and damage the lungs causing breathing problems. Fine particles are easily inhaled deeply into the lungs where they can be absorbed into the blood stream or remain embedded for long periods of time.

Climatic effects: -

Normally pollutants rise or flow away from their sources without building up to unsafe levels. Wind patterns, clouds, rain, and temperature can affect how quickly pollutants move away from an area. Weather patterns that can trap air pollution in valleys or move it across the globe may be able to damage pristine environments far from the original sources.

1.10.2.1.2 The sources of air pollution are

Some of the main contributors to air pollution are: Automobile emissions , Tobacco smoke, Combustion of coal, Acid rain, Noise pollution from cars and construction, Power plants, Manufacturing buildings, Large ships, Paint fumes, Aerosol sprays, Wildfires, Nuclear weapons

1.10.2.1.3 Facts about Air Pollution

Here are a few facts about air pollution:

- Almost 120 million different types of vehicles are driven by India citizens every day, adding greenhouse gases into the air.
- Indian vehicle emissions contribute 45% to global warming
- The average adult consumes 3,000 gallons of polluted air every day
- Vehicle exhaust contributes to 60% of carbon monoxide emissions in the U.S. and up to 95% in large cities
- Every year 335,000 Americans die of lung cancer, which is a direct result of air pollution.

1.10.2.1.4 Effects of Air pollution: -

Many studies have shown links between pollution and health effects. Increases

in air pollution have been linked to decreases in lung function and increases in heart attacks. High levels of air pollution according to the EPA Air Quality Index directly affect people with asthma and other types of lung or heart disease. Overall air quality has improved in the last 20 years but urban areas are still a concern. The elderly and children are especially vulnerable to the effects of air pollution. The effects of air pollution are diverse and numerous. Air pollution can have serious consequences for the health of human beings, and also severely affects natural ecosystems. Because it is located in the atmosphere, air pollution is able to travel easily. As a result, air pollution is a global problem and has been the subject of global cooperation and conflict. Many diseases could be caused by air pollution without their becoming apparent for a long time. Diseases such as bronchitis, lung cancer, and heart disease may all eventually appear in people exposed to air pollution. Air pollutants such as ozone, nitrogen oxides, and sulfur dioxide also have harmful effects on natural ecosystems. They can kill plants and trees by destroying their leaves, and can kill animals, especially fish in highly polluted rivers. Like photochemical pollutants, sulfur oxides contribute to the incidence of respiratory diseases. Acid rain, a form of precipitation that contains high levels of sulfuric or nitric acids, can contaminate drinking water and vegetation, damage aquatic life, and erode buildings. When a weather condition known as a temperature inversion prevents dispersal of smog, inhabitants of the area, especially children and the elderly and chronically ill, are warned to stay indoors and avoid physical stress. The dramatic and debilitating effects of severe air pollution episodes in cities throughout the world—such as the London smog of 1952 that resulted in 4,000 deaths—have alerted governments to the necessity for crisis procedures. Even everyday levels of air pollution may insidiously affect health and behavior. Indoor air pollution is a problem in developed countries, where efficient insulation keeps pollutants inside the structure. In less developed nations, the lack of running water and indoor sanitation can encourage respiratory infections. Carbon monoxide, for example, by driving oxygen out of the bloodstream, causes apathy, fatigue, headache, disorientation, and decreased muscular coordination and visual acuity.

1.10.2.1.5 Control measures for air pollution: -

Air pollution can be controlled by two fundamental approaches: preventive techniques and effluent control. One of the effective means of controlling air pollution is to have proper equipment in place. This includes devises for removal

of pollutants from the flue gases though scrubbers, closed-collection recovery systems, the use of dry and wet collectors, filters, electrostatic precipitators, etc.

Building higher smoke stacks facilitates the discharge of pollutants as far away from the ground as possible. Industries should be carefully located so as to minimize the effect of pollution after controlling the topography and the wind direction. The substitution of raw materials that cause more pollution with those that cause less pollution will also help.

1.10.2.1.6 Air Pollution in India

The World Health Organisation (WHO), which rates only the mega cities of the world, has rated New Delhi as the fourth most polluted city in the world. However, compared to other cities in India, Delhi is not at the top of the list of polluted cities. Our country has several pollution hotspots. The recent release from the Central Pollution control Board (CPCB), Parivesh, January 2003, states that Ahmedabad's air is the most noxious, followed by Kanpur, Sholapur and lucknow, with small particulate levels 3-4 times the standard of 60 microgram per cubic meter. The report has ranked 29 cities according to the Respirable Particulate Matter (RSPM) levels recorded during the year 2000. This report thus confirms the fact that Indian cities show high particulate pollution, with 14 cities hitting critical levels. The CPCB indicates vehicles as one of the predominant source of air pollution. However, the stringent measures implemented in Delhi over the last few years such as introduction of Euro II standards, lowering the sulfur content in fuel to 500 ppm, and implementing the Compressed Natural Gas (CNG) program have succeeded in improving the quality of air.

It is alarming to note that residential locations in India are fast outpacing industrial locations in air pollution, implying that vehicular fumes are responsible for this trend. The Supreme Court's order of April 5, 2002, has directed the Central Government to prepare an action plan for other polluted cities. The absence of any local initiatives for action and the delay in air pollution control measures have made the situation worse.

The Supreme Court also played a vital role in protecting the Taj Mahal. Being exposed to sulfur dioxide and suspended particulate matter, the Taj has contracted 'marble cancer' , a fungal growth that corroded its surface giving it a yellowish tinge. Shri MC Mehta, an environmental lawyer, filed a public interest

litigation (PIL) in 1984 expressing concern over the havoc the polluting units in Agra were wreaking on the Taj Mahal. Twelve years later, the Supreme court ordered 292 industries in the vicinity, to either adopt pollution control measures or shut down. It also made it mandatory for these units to either switch over to eco friendly fuels like natural gas or shift out of the area.

1.10.2.1.7 Legal aspect of air pollution control in India

The Air (Prevention and Control of Pollution) Act was legislated in1981. The Act provided for prevention, control and abatement of air pollution. In the areas notified under this Act, no industrial pollution causing activity could come up without the permission of the concerned SPCB. But this Act was not strong enough to play a precautionary or a corrective role. After the Bopal disaster, more comprehensive Environment Protection Act (EPA) was passed in 1986. This act for the first time conferred enforcement agencies with necessary punitive powers to restrict any activity that can harm the environment. To regulate vehicular pollution, the Central Motor Vehicles Act of 1939 was amended in 1989.

1.10.2.1.8 Prevention of Air Pollution

The number one way to prevent air pollution is to walk or bike more and drive less. This will prevent fossil fuels from polluting the air. Here are some other ways to prevent air pollution:

- Carpool or join a ride share with friends and coworkers
- Don't smoke
- Keep your car maintenance up-to-date
- If you have to drive, do your errands at one time
- Don't buy products that come in aerosol spray cans
- Avoid using lighter fluid when barbecuing outside
- When you drive accelerate slowly and use cruise control
- Always replace your car's air filter
- Use a push or electric lawnmower rather than a gas-powered one
- Don't use harsh chemical cleaners that can emit fumes
- Inspect your gas appliances and heaters regularly

1.10.2.2 Water Pollution

Water is the essential element that makes life on Earth possible. Without water there would be no life. We usually take water for granted. It flows from our taps when they are turned on; most of us are able to bathe when we want to, swim when we choose and water our gardens. Like good health we ignore water when we have it.

Water covers 70% of the earth and only 3% of fresh water. 1% of fresh water and 2% of frozen fresh water. About 97% of the total water available on Earth is found in the oceans and is too salty for drinking or irrigation.

In short, if the world's water supply were only 100 liters our usable supply of fresh water would be only about 0.003 liters (one half teaspoon). This makes water a very precious resource. The future wars in our world may well be fought over water. By the middle of this century, almost twice as many people will be trying to share the same amount of freshwater the earth has today. In the future, as freshwater becomes scarcer, the access to water resources will be an important factor in determining the economic growth of several countries around the world.

1.10.2.2.1 What is water pollution?

Water pollution is the introduction of chemical, biological and physical matter into large bodies of water that degrade the quality of life that lives in it and consumes it. When the quality or composition of water changes directly or indirectly as a result of man's activities such that it becomes unfit for any purpose it is said to be polluted. Water pollution is a major cause to life. It impacts on marine life and is a major impact to life in the whole world.

Subsequently, we are slowly but surely harming our planet to the point where organisms are dying at a very alarming rate. In addition to innocent organisms dying off, our drinking water has become greatly affected as is our ability to use water for recreational purposes. In order to combat water pollution, we must understand the problems and become part of the solution.

1.10.2.2.2 Causes of water pollution

Many causes of water pollution including sewage and fertilizers contain nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms

consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters.

The pollution is also caused when silt and other suspended solids, such as soil, wash off plowed fields, construction and logging sites, urban areas, and eroded river banks when it rains. Under natural conditions, lakes, rivers, and other water bodies undergo Eutrophication, an aging process that slowly fills in the water body with sediment and organic matter. When they sediments various bodies of water, fish and other marine life respiration becomes impaired. Pollution in the form of organic material enters waterways in many different forms as sewage, as leaves and grass clippings, or as runoff from livestock feedlots and pastures.

When natural bacteria and protozoan in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many fish or other marine life can not survive when oxygen levels drop below two to five parts per million. When this occurs, the fish will gradually die and the food chain will get disrupted meaning the marine life will gradually disappear.

1.10.2.2.3 Sources of water pollution

When a source of pollution can be readily identified because it has a definite source and place where it enters the water it is said to come from a point source. Eg. Municipal and industrial discharge pipes. When a source of pollution can not be readily identified, such as agricultural runoff, acid rain etc. they are said to be non-point source of pollution. Some of the main contributors to water pollution are Factories, Refineries, Waste treatment facilities, Mining, Pesticides, herbicides and fertilizers, Human sewage, Oil spills, Failing septic systems, Soap from washing your car, Oil and antifreeze leaking from cars, Household chemicals, Animal waste etc.

1.10.2.2.4 Facts about Water Pollution

Here are a few facts about water pollution:

- Over two-thirds of U.S. estuaries and bays are severely degraded because of nitrogen and phosphorous pollution.
- Every year almost 25% of U.S. beaches are closed at least once because of water pollution

- Over 73 different kinds of pesticides have been found in the groundwater that we eventually use to drink.
- 1.2 trillion gallons of sewage, storm water and industrial waste are discharged into U.S. waters every year.
- 40% of U.S. rivers are too polluted for aquatic life to survive.
- Americans use over 2.2 billion pounds of pesticides every year, which eventually washes into our rivers and lakes

1.10.2.2.5 The state of India's rivers

Indians have always had a tradition of venerating their rivers. Most of the rivers in India are named after gods, goddesses or saints. However, a large majority of the Indian population, including those who worship the rivers, don't think twice before polluting a river. Urbanization, industrialization, excess withdrawal of water, agricultural run-off, improper agricultural practices and various religious and social practices all contribute to river pollution in India. Every single river in India – be it the Ganga, Yamuna, Cauvery or Krishna – has its own share of problems due to pollution. Waters from the Ganga and the Yamuna are drawn for irrigation through the network of canals as soon as these rivers reach the plains, reducing the amount of water that flows downstream. What flows in the river now is water from small nalas and streams that carry with them sewage and industrial effluents. The residual freshwater is unable to dilute the pollutants and the rivers turn into stinking sewers. In spite of the data from scientifically competent studies conducted by the CPCB, the Government has not been able to tackle this issue. Sewage and municipal effluents account for 75% of the pollution load in rivers while the remaining 25% is from industrial effluents and nonpoint sources.

In 1985, India launched the Ganga Action Plan (GAP), the largest ever river clean up operation in the country. The plan has been criticized for overspending and slow progress. The GAP Phase – II in 191 included cleaning operations for the tributaries of the Ganga, i.e. the Yamuna , Gomti and the Damodar. Thus the Yamuna Action Plan (YAP), the Gomti Action Plan and the Damodar Actino Plan (DAP) were added.

In 1995, the National River Conservation plan was launched. Under this, all the rivers in India were taken up for cleanup operations. In most of these plans, attempts have been made to tap drains and divert the sewage to sewage treatment

plants, before letting out the sewage into the rivers. The biggest drawback of these river cleaning programs was that they failed to allot responsibilities as to who would pay for running the treatment facilities in the long run. With the power supply being erratic and these plants being heavily dependent on power, most of these facilities lie underutilized. Moreover, the problem of river pollution due to agricultural run –off has not been addressed in these programs. The NRCP is scheduled to be completed by March 2005. The approved cost for the plan is Rs. 772.08 crores, covering 18 rivers in 10 states, including 46 towns. The cost is borne entirely by the Central Government and the Ministry of Environment and Forests is the nodal agency that coordinates and monitors the plan. Under this plan, the major activities include treating the pollution load from sewer systems of town and cities, setting up sewage treatment plants, electric crematoria, low-cost sanitation facilities, riverfront development, afforestation and solid waste management.

1.10.2.2.6 Control measures for preventing water pollution

While the foremost necessity is prevention, setting up effluent treatment plants to treat waste can reduce the pollution load in the recipient water. The treated effluent can be reused for either gardening or cooling purposes, wherever possible. A few years ago a new technology, called the Root Zone Process, has been developed by Thermax. This system involves running contaminated water through the root zones of specially designed reed beds. The reeds, which are essentially wetland plants, have the capacity to absorb oxygen from the surrounding air through their stomatal openings. The oxygen is pushed through the porous stem of the reeds into the hollow roots where it enters the root zone and creates conditions suitable for the growth of numerous bacteria and fungi. These microorganisms oxidize impurities in the wastewaters, so that the water which finally comes out is clean.

1.10.2.2.7 Preventing Water Pollution

The best way to prevent water pollution is to not throw trash and other harmful chemicals into our water supplies. Here are a few more ways you can prevent water pollution:

- Wash your car far away from any storm water drains
- Don’t throw trash, chemicals or solvents into sewer drains

- Inspect your septic system every 3-5 years
- Avoid using pesticides and fertilizers that can run off into water systems
- Sweep your driveway instead of hosing it down
- Always pump your waste-holding tanks on your boat
- Use non-toxic cleaning materials
- Clean up oil and other liquid spills with kitty litter and sweet them up
- Don't wash paint brushes in the sink

1.10.2.3 Land Pollution

Land pollution is pollution of the Earth's natural land surface by industrial, commercial, domestic and agricultural activities.

1.10.2.3.1 Sources of land pollution

Some of the main contributors to land pollution are Chemical and nuclear plants, Industrial factories, Oil refineries, Human sewage, Oil and antifreeze leaking from cars, Mining, Littering, Overcrowded landfills, Deforestation, Construction debris

1.10.2.3.2 Facts about Land Pollution

Here are a few facts about land pollution:

- Every year one American produces over 3285 pounds of hazardous waste.
- Land pollution causes us to lose 24 billion tons of top soil every year.
- Americans generate 30 billion foam cups, 220 million tires and 1.8 billion disposable diapers every year.
- We throw away enough trash every day to fill 63,000 garbage trucks.
- Every day Americans throw away 1 million bushels of litter out their car window.
- Over 80% of items in landfills can be recycled, but they're not.

1.10.2.3.3 How to Prevent Land Pollution

The best way to prevent land pollution is to recycle. Here are a few other ways you can reduce land pollution:

- Reuse any items that you can

- Buy biodegradable products
- Store all liquid chemicals and waste in spill-proof containers
- Eat organic foods that are grown without pesticides
- Don't use pesticides
- Use a drip tray to collect engine oil
- Buy products that have little packaging
- Don't dump motor oil on the ground

Mismanagement of the land will cause is becoming a big problem. The pollution it causes are soil erosion, degradation and salinisation are just a few other problems facing the state of our land. The causes are losing 6 hectares of land every year and losing 24 billion tons of top soil. Globally we are losing a minimum of 15 million acres of prime agricultural land to overuse and mismanagement every year. Desertification is threatening about one third (sixteen million square miles) of the world's land surface.

1.10.2.4 Soil Pollution

We can no more manufacture soil with a tank of chemicals than we can invent a rainforest or produce a single bird. We may enhance the soil by helping its processes along, but we can never create what we destroy. The soil is a resource for which there is no substitute.

The soil is a thin covering over the land consisting of a mixture of minerals, organic material, living organisms, air and water, that together support the growth of plant life. Several factors contribute to the formation of soil from the parent material. This includes the mechanical weathering of rocks due to temperature changes and abrasion, wind, moving water, glaciers, chemical weathering activities, and lichens. Climate and time are also important in the development of soils. In extremely dry or cold climates soils develop very slowly, while in humid and warm climates soils develop more rapidly. Under ideal climatic conditions, soft parent material may develop into 1 cm of soil within 15 years. Under poor climatic conditions, a hard parent material may require hundreds of years to develop into soil.

Soil vary in their content of clay (very fine particles), silt (fine particles), sand (medium size particles) and gravel (coarse to very coarse particles). The relative

amount of the different sizes and types of mineral particles determine the soil texture. Soil with approximately equal mixtures of clay, sand, silt and humus are called loams.

1.10.2.4.1 Causes of soil degradation

Erosion

Soil erosion can be defined as the movement of surface litter and topsoil from one place to another. While erosion is a natural process, often caused by wind and flowing water, it is greatly accelerated by human activities such as farming, construction , overgrazing by livestock, burning of grass cover, and deforestation.

The loss of the topsoil makes a soil less fertile and reduces its water holding capacity. The topsoil, which is washed away, also contributes to water pollution by clogging lakes and increasing the turbidity of the water, ultimately leading to the loss of aquatic life. For each inch of topsoil to be formed it normally requires 200-1000 years, depending upon the climate and soil type. Thus, if the topsoil erodes faster than it is formed, the soil becomes a non renewable resource.

Therefore, it is essential that proper soil conservation measures are used to minimize the loss of the topsoil. There are several techniques that can protect the soil from erosion. Today, both water and soil are conserved through integrated treatment methods. The two types of treatment generally used are Area treatment, which involves treating the land and Drainage line treatment, which involves treating the natural water courses.

Continuous contour trenches

It can be used to enhance the infiltration of water, reduce the run-off, and check soil erosion. These are actually shallow trenches dug across the slope of the land and along the contour lines, basically for the purpose of soil and water conservation. They are most effective on gentle slopes and in areas of low to medium rainfall. These bunds are stabilized by fast growing tree species and grasses. In area with steep slopes were bunds are not possible, continuous contour benches (CCBs) made of stones are used for the same purpose.

Gradonies

It can also be used to convert wastelands into agricultural lands. In this, narrow trenches with bunds on the downstream side are built along contours in the

upper reaches of the catchment to collect run off and to conserve moisture from the trees or tree crops. The area between the two bunds is used for cultivating crops after development of fertile soil cover.

Excess use of fertilizers

Approximately 25% of the world crop yield is estimated to be directly attributed to the use of chemical fertilizers. The use of chemical fertilizers has increased significantly over the last few decades and is expected to rise even higher. Fertilizers are very valuable, as they replace the soil nutrients used up by plants. The three primary soil nutrients often in short supply are potassium, phosphorus and nitrogen compounds. Certain other elements like boron, zinc and manganese are necessary in extremely small amounts and are known as micronutrients. When crops are harvested, a large amount of macronutrients and a small amount of micronutrients can result in decreased yields. These necessary nutrients can be returned to the soil through the application of fertilizers. In addition to fertilizers, a large amount of pesticides are also used to ensure a good yield. Pesticides can be sub divided into several categories based on the kind of organisms they are used to control. Insecticides are used to control insect populations while fungicides are used to control unwanted fungal growth. Mice and rats are killed by rodenticides, while plant pests are controlled by herbicide use.

Excess salt and water

Irrigated lands can produce higher crop yields than those that only use rainwater. However this has its own set of ill effects. Irrigation water contains dissolved salts andin dry climates much of the water in the saline solution evaporates leaving its salts, such as sodium chloride in the topsoil. The accumulation of these salts is called salinization, which can stunt plant growth, lower yields and eventually kill the crop and render the land useless for agriculture. These salts can be flushed out of the soil by using more water. This practice, however, increases the cost of crop production and also wastes enormous amounts of water. Flushing out salts can also make the downstream irrigation water saltier.

1.10.2.5 Marine pollution

Marine pollution can be defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as

hazards to human health, obstruction of marine activities, and lowering the quality of sea water.

1.10.2.5.1 Causes of Marine pollution

While the causes of marine pollution may be similar to that of general water pollution, there are some very specific causes that pollute marine waters.

- The most obvious inputs of waste is through pipes directly discharging wastes into the sea. Very often, municipal waste and sewage from residences and hotels in coastal towns are directly discharged into the sea.
- Pesticides and fertilizers from agriculture, which are washed off the land by rain, enter water courses and eventually reach the sea.
- Petroleum and oil washed off from the roads normally enter the sewage system but stromwater overflows carry these materials into rivers and eventually into the seas.
- Ships carry many toxic substances such as oil, liquefied natural gas, pesticides, industrial chemicals, etc. , in huge quantities sometimes to the capacity of 350000 t.ship accidents and accidental spillages at sea can, therefore, be very damaging to the marine environment. Shipping channels in estuaries and at the entrances to ports often require frequent dredging to keep them open. This dredged material that may contain heavy metals and other contaminants is often dumped out at sea.
- Offshore oil exploration and extraction also pollute the sea water to a large extent.

1.10.2.5.2 Control Measures

One way of reducing the pollution load on marine water is through the introduction of sewage treatment plants. This will reduce the biological oxygen demand of the final product before it is discharged to the receiving waters. Various stages of treatment such as primary secondary or advance can be used, depending on the quality of the effluent that is required to be treated.

1.10.2.6 Noise Pollution

Noise may not seem as harmful as the contamination of air or water, but it is a pollution problem that affects human health and can contribute to a general

deterioration of environmental quality.

Noise is undesirable and unwanted sound. Not all sound is noise. What may be considered as music to one person may be noise to another. It is not a substance that can accumulate in the environment like most other pollutants. Sound is measured in a unit called the decibel.

There are several sources of noise pollution that contribute to both indoor and outdoor noise pollution. Noise emanating from factories, vehicles and playing of loudspeakers during various festivals can contribute to outdoor noise pollution while loudly played radio or music system, and other electronic gadgets can contribute to indoor noise pollution. The difference between sound and noise is often subjective and a matter of personal opinion. There are however some very harmful effects caused by exposure to high sound levels. These effects can range in severity from being extremely annoying to being extremely painful and hazardous.

1.10.2.6.1 Effects of noise pollution on physical health

The most direct harmful effect of excessive noise is physical damage to the ear and the temporary or permanent hearing loss often called a temporary threshold shift. People suffering from this condition are unable to detect weak sounds. However hearing ability is usually recovered within a month of exposure. In Maharashtra, people living in close vicinity of Ganesh mandals that play blaring music for ten days of the Ganesh festival are usually know to suffer from this phenomenon. Permanent loss, usually called 'noise induced permanent threshold shift' (NIPTS) represent a loss of hearing ability from which there is no recovery.

Below a sound level of 80dB hearing loss does not occur at all. However temporary effects are noticed a sound level between 80 and 130dB. About 50% of the people exposed to 95dB sound levels at work will develop NIPTS. And most people exposed to more than 105dB will experience permanent hearing loss to some degree. A sound level of 150dB or more can physically rupture the human eardrum.

1.10.2.6.2 Effect of noise pollution on mental health

Noise can also cause emotional or psychological effects such as irritability, anxiety and stress. Lack of concentration and mental fatigue are significant health effects of noise. It has been observed that the performance of school children is

poor in comprehension tasks when schools are situated in busy areas of a city and suffer from noise pollution.

As noise interferes with normal auditory communication, it may mask auditory warning signals and hence increases the rate of accidents especially in industries. It can also lead to lowered worker efficiency and productivity and higher accident rates on the job.

Thus noise is just more than a mere nuisance or annoyance. It definitely affects the quality of life. It is therefore important to ensure the mitigation or control of noise pollution.

1.10.2.6.3 Noise control techniques

There are four fundamental ways in which noise can be controlled i.e. reduce noise at sourse, block the path of noise, increase the path length, and protect the recipient. In general, the best control method is to reduce noise level at the source.

Source reduction can be done by effectively muffling vehicles and machinery to reduce the noise. In industries, noise reduction can be done by using rigid sealed enclosures around machinery lined with acoustic absorbing material. Isolating machines and their enclosures from the floor, using special spring mounts or absorbent mounts and pads. And usually flexible couplings for interior pipelines also contribute to reducing noise pollution at the source.

However, one of the best methods of noise source reduction is the regular and thorough maintenance of operating machinery. Noise levels at construction sites can be controlled using proper construction planning and scheduling techniques. Locating noisy air compressors and other equipment away from the site boundary, along with creating temporary barriers to physically block the noise, can contribute to reducing noise pollution.

Most of the vehicular noise comes from the movement of the vehicle tires on the pavement and wind resistance. However, poorly maintained vehicles can add to the noise levels. Traffic volume and speed also have significant effects on the overall sound. For example, doubling the speed increases the sound levels by about 9dB and doubling the traffic volume increases the sound level by about 3dB. A smooth flow of traffic also causes less noise than does a stop and go traffic pattern. Proper highway planning and design are also essential for

controlling traffic noise. Establishing lower speed limits for highways that pass through residential areas, limiting traffic volume, and providing alternative routes for truck traffic are effective noise control measures. The path of traffic noise can also be blocked by constructing vertical barriers alongside the highway.

1.10.3 Summary

Pollution has become a major issue over the years because it contaminates the Earth's environment and affects human health. While some environmental pollution is a result of natural causes such as volcanic eruptions, most is caused by human activities. The increase of various types of pollution has made cancer pollutant more prevalent among the people, raising the risk of getting cancer. After being exposed to these pollutants, the effects may be immediate or delayed. Some of the delayed effects, due to the exposure, can go unnoticed for many years. Another major issue that pollution creates is the tremendous cost for preventing and cleaning it up. However, we can not regulate the pollutants to the extent where there are no more possible threats. The most we can do is to minimize the effects of the potential risks, which we may encounter as a society. We can approach this matter by conducting different types of test from animal studies and epidemiological studies.

1.10.4 Suggested Questions

1. What is Pollution ?
2. What are the different types of pollution ? Discuss in brief.
3. What is the role of individuals in prevention of pollution.

1.10.5 Suggested Readings

1. Text book of Environmental Studies - Dr. K. Raghavan Nambiar
2. Environmental Studies - R.R. Dass
3. Environmental Studies - R. Rajagopalam
4. Environmental Education - R.A. Sharma

B.A./B.Com./BBA/BCA PART-II

SEMESTER-III

ENVIRONMENTAL AND ROAD SAFETY AWARENESS

Department of Distance Education

Punjabi University, Patiala

Lesson Nos. :

UNIT-B

Note:- The students can download syllabus from departmental website **www.pbidde.org**

Lesson No. 2.1 **Author : Ms. Ravneet Kaur**

DISASTER MANAGEMENT : FLOODS, EARTHQUAKES, CYCLONES AND LANDSLIDES

2.1.0 Objectives

The scope of this lesson is to familiarise you with the basics of disaster management. After studying this lesson, you will be able to understand :

- What are disasters?
- Various types of disasters
- Managing various disasters like earthquakes, floods, cyclones and landslides, snow avalanches, some other disasters like fires, draught etc. and some other considerations in disaster management.

2.1.1 Introduction

It is beyond the control of human beings to stop the occurrence of disasters in the natural environment but we can somehow manage the after effects of the disaster in a professional manner. And we can even have some safeguards also especially in the areas which have been declared as disaster prone areas by scientists and governments.

2.1.2 What are disasters?

Disasters can be broadly classified in two types, i.e. natural; and man-made.

I. Natural Disasters

Natural disasters are natural occurrences in the nature. They occur suddenly without any warning usually, but now in some cases they can be predicted also by some warning signs as established by scientists and public can be warned in those areas before the occurrence of the disasters. Even nature has made some system in animals also like cattle can know before hand about a coming earthquake and then these animals go for reaching places where they feel safe without warning signals in the atmosphere.

Natural disasters includes floods, earthquakes, hurricanes, landslides, cyclones, tornadoes, volcanic, eruptions etc.

II. Man-made Disasters

Technology has empowered man to initiate disasters. Man-made disasters include wars, terrorist attacks, bomb explosions etc. The 9/11 in 2001 at World Trade Centre, New York; 7/7 in 2005 at London Underground Metro; 26/11 recently in Mumbai Taj Hotel etc. are examples of man-made disasters.

Sometimes, some accidents also result in disasters like gas leakage, The Bhopal Tragedy; collision of two trains; oil spills; air accidents; nuclear explosions etc.

2.1.3 Earthquakes

Earthquake is a sudden movement or shift of the earth's crust below or at the surface that results in ground vibration. When the ground tremors suddenly, an earthquake occurs. There is a point where it originates known as epicentre. Seismic waves are caused by sudden break-up of rocks in the earth or it may occur after an explosion also. And thus earthquakes occur at the earth's upper crust.

Earthquakes are measured on a Richter scale. The earthquakes occurring upto 4.0 may not be much dangerous as casual tremors are felt only but those occurring on a Richter Scale of more than 5.0 become dangerous. The more the Richter Scale on which an earthquake occurs, the more drastic is it, i.e. an earthquake occurring at 8.0 is highly dangerous as compared to 5.5.

There have been many major earthquakes in India, like :

Year	Place	At Richter Scale
1905	Kangra (H.P.)	8.0
1975	Kinnaur, Lahaul and Spiti (H.P.)	7.5
1993	Latur (Maharashtra)	6.4
2001	Bhuj (Gujarat)	7.7
2005	Kashmir	7.6

Tsunami of 2004 is still afresh with epicentre in Sumatra (Indonesia) but its effects were seen in India also. And in 2005 the epicentre was in Pakistan but much damage occurred in India also with 7.6 Richter Scale. Hence, earthquakes don't bother about national boundaries and can destroy a large area depending upon where it originated and on which Richter Scale it occurs.

But in Japan, as it is an island, earthquakes are a normal part of its life as light tremors do occur casually there and sometimes very high intensity earthquakes also come along. 1st September in Japan is observed so as to check earthquake preparedness and mock drills are exercised to check emergency safeguards. And also in Japan, earthquake resistant technology is used to construct buildings with which earthquakes may not destroy the buildings.

Earthquakes may be predicted by monitoring seismic activity but exact timing of their occurrence may not be predicted.

By making earthquake resistant buildings, some damage can be prevented but this is a costly affair. With Base Isolation Devices and Seismic Dampers technologies earthquake resistant buildings can be built.

Earthquakes damage buildings, other structures and sometimes some other problems also present themselves like fire, floods etc.

And loss by deaths cannot be left out as apart from humans. Many other species dies also and a large number of others wounded. Even water, electricity,

communication system, food etc. also got affected and sometimes it can even lead to accidents also. And any building can get damaged whether houses, schools, commercial government etc. And even the removal of people who are alive but in wounded condition or dead bodies is also a problem because it is not easy to side away debris quickly. Even many anti-social elements also enter the disaster affected areas and loot the remainings from dead bodies or alive ones like jewellery.

And shortage of food, clothes, drinking water and shelter are the basic needs of survivors alongwith emergency medical help. So rescue operations include first-aid, help of other people whether volunteers or armed forces personnel.

But on the topic of mitigation, many scholars has advised that preparedness is better than doing relief after the occurrence of the disaster. But this means not only mass public awareness but also some skills like first-aid and availability of resources also matters otherwise knowledge may not prove good without tools.

Designation/declaration and finding of earthquake prone areas can be done. Even standards and by-laws have been made by Indian Government but these are not strictly implemented in all cases.

In rural areas, constructions are not proper as these are made of wood and mud without cement and bricks, so these are more dangerous but poverty is the main problem here.

And media plays an important role by disseminating information and public awareness and also with news coverage so that rescue operations should be initiated at the earliest. And hospitals also should have emergency facilities to handle a large number of casualties.

2.1.4 Floods

Floods are caused by overflow of waters. Heavy rainfall is the major reason for the occurrence of floods. Like in India, we have many rivers in various states and in some regions like Orissa, floods occur usually each year.

Floods occurring due to dam failure, run-off of water, breaking of ice are called **Flash Floods**.

And floods occurring in rivers due to seasons especially monsoons, are called **River floods**.

Adverse effects of floods, are life threatning to humans and other species as well. Displacement of people, houses, damage to crops, cattle etc. Even diseases like malaria and other water borne diseases also present themselves.

Mitigation of the disaster of floods can be done in various ways like flood forecasting and pre-preparedness to handle floods and managing the after effects of floods i.e. emergency help and rehabilitation of the affected victims.

Flood forecasting can be done by various methods like Flood Routing Technique, Inflow-Outflow Correlation, Curves etc. Floods can be predicted on seasonal patterns usually like in monsoons, flood plain mapping etc. Many factors are to be considered like how much deep is the water, duration, velocity, season, etc.

Reducing of risk can be flood control with channels, dams, etc. Flood detection and warning systems can be developed alongwith public awareness. But immediate rescue operations must be started at the earliest like medical aid, food, drinking water, shelter etc.

Floods can be managed by some construction activities also like dams, reservoirs, basins, flood walls, channels, etc.

Depending upon the timing or season, some areas can be designated as flood prone areas where each year re-occurrence of the floods takes place.

Our government also grants various types of funds to prevent, control and manage the after effects of floods for the people of various states and some other plans, policies and programmes with various organizations like NGOs, NIC (National Informatics Centre), government departments etc.

2.1.5 Cyclones

There are many terms associated with cyclones depending upon their severity. These are also referred to as coastal floods like storms, tropical cyclones, typhoons, hurricanes, tornadoes, tsunamis, katria, Rita etc. as they occur usually near coastal regions. Cyclones are a major problem even in America as these disrupt the life and cause major destruction also. In India, we have Indian Ocean regions, Bay of Bengal etc. as cyclone prone areas.

A tropical cyclone like hurricane is a storm of wind with very high speed like more than 100 kilometers per hour. These occur due to natural process of air, heat, sun etc. and beyond the power of humans to stop them. They can affect a large area depending upon its speed, velocity, direction in which it is coming

etc. It has a central area where the air circulates known as the eye of the storm and strong winds come along even with heavy rainfall and lighting also in some cases.

Cyclones can last from some minutes to hours, even days also. There have been many such occurrences in America alongwith other parts of the world including India like the Tsunami in 2004.

Tornadoes are the highly severe wind storms as tropical thunder storm. As a tornado is visible as a vortex, a whirlpool structure of winds rotating around a hollow cavity in which centrifugal forces produce of partial vacuum.

Cyclones can be forecasted by regular monitoring by our meteorological departments and hence warnings are issued before hand, but the forecasting of tsunamis is difficult and very costly also and this technology is not available all over the world. But efforts are being done by our government also to forecast such disasters.

With cyclones sometimes heavy rainfall also comes alongwith lightning and these produce highly adverse effects like destruction of buildings, drowning, loss of life of people and other species, disruption of electricity, drinking water, stoppage of communication systems like telephones, internet, and even air accidents also etc.

Although various warnings are issued by government through media about the occurrence of cyclones but sometimes some poor people don't take them seriously like fishermen because their daily earnings depend upon fishing alone.

Many steps can be undertaken to manage cyclones like early warnings, pre-preparedness to handle disasters, managing the after effects of cyclones etc. like warnings may include the timing, speed, direction, area likely to be affected etc.

There are various mitigation issues which have been undertaken by Indian government through various departments, organizations, NGOs etc. Like the ACWCs (Area Cyclone Warning Centres) issue such warnings located in different states and CWCs (Cyclone Warning Centres) in other cities. Many committees in various states are also working like CDMC (Cyclone Distress Mitigation Committees) and CRCs (Cyclone Review Committees) are present in many states of our country.

Management and mitigation includes various considerations in disasters occurrence, like forecasting, issuance of warnings, emergency services of medical aid, food, drinking water, clothes, shelter etc., help of armed forces personnel, NGOs, volunteers like donating food, money, blankets etc. and even rehabilitation of affected victims also.

2.1.6 Landslides

Landslides occur due to rapid downward movement under the influence of gravity of a mass of rock, earth or other things on a slope. Landslides may be classified in two categories broadly - (a) according to the type of movement; (b) according to the type of material. The movement can be either slow or fast, but the more rapidly moving landslides pose greater hazards to life. Fast speeds even leave little time for warning. And apart from movement, a landslide can also be classified as a flow or fall or topple. A flow can be a thick mixture of mud, often called mudslide, or broken rocks also like debris, bedrock etc.

Based on the type of movement, relative rate of movement, and kind of material involved, landslides can be broadly designated in five kinds - (a) slump with earth flow; (b) debris slide; (c) debris fall; (d) rock slide; and (e) rock fall.

As landslides are a combination of rock slide and rock fall. They involve movement of mass (soil, debris or rock). The process of movement of mass may vary from slow soil creep to abrupt and sudden rockfall.

Landslides, being more widespread in different mountains or hilly regions of the country, like Himalayas, Badrinath causalities, North-East Hills, Western Ghats, Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh etc. viz. in 2005 the Tibet landslides created an artificial lake on the river Purchu, posing a great threat to Himachal Pradesh. They cause damage which is more varied and more widespread. Increased population, quarrying, mining and construction activities near unstable hill slopes, ill-conceived developmental activities in the vulnerable hilly areas have resulted in more incidents of landslides. And the adverse effects of landslides includes loss of life of people and animals, destruction of property, roads blockage, etc. The disappearance of land and cultivable top soil takes away the agricultural potential of the affected area thus depriving them of their already meagre livelihood.

Landslides are also known to result in blocking of streams or over flowing of lakes thus causing flash floods because large volumes of debris falling in a lake

or reservoir cause its water to overflow or the temporarily blocked stream may suddenly release the huge quantity of impounded water to cause a devastating flash flood downstream.

Mitigation issues include forecasting of landslides, issuance of warnings, first-aid, medical facilities, clearance of roads, streams, other ways, making of temporary roads, bridges, help of armed forces personnel etc.

2.1.7 Snow Avalanches

Snow avalanches are large mass of snow, ice, earth, rock or other materials in swift motion down a mountain side. These may be classified as dry snow or wet snow type with direct and delayed action avalanches. Dry snow avalanches occur when new snow slides over old stable snow. Wet snow avalanches occur when rainfall or warm weather occurs immediately after snowfall e.g. spring than avalanche. In such a case, the snow avalanche consists primarily of melting snow mixed with water but takes alongwith it any other material enroute. Wet snow avalanches also occur during spring seasons when heavy accumulations of snow become loose with the start melting process.

Snow avalanches occur due to many reasons depending upon climate, wind conditions, topography, velocity of winds etc. These are generated due to the structural failure of snow heap lying on mountain slopes like large accumulation of snow from heavy snowfall creating excessive loading; sound waves from any loud noise; excessive melting of snows; etc. In case of specific kinds of snow avalanches, the resultant damage is quite characteristic. Due to the nature of the rocks of the Himalayan mountains, the snow avalanche may also carry large quantity of debris, stones etc. There are many hilly regions in India where snow avalanches occur like in Himachal Pradesh, Jammu & Kashmir, Uttranchal etc. DRDO (Defence Research and Development Organization) monitors snow avalanches in our country.

There are many issues involved in mitigation like forecasting and issuance of warnings in snow avalanches with medical emergencies, food, shelter, help of armed force personnel etc.

2.1.8 Other Disasters

(a) **Fires :** The large fires anywhere can take place whether man-made like in bomb explosions by terrorists; or they can be natural also like forest

fires. The services of fire-brigade department are much sought after but local public can be trained also in some buildings alongwith fire-extinguishers, sand, water etc.

(b) **Draught :** Draught can also be categorised as a disaster. It is primarily a deficiency in rainfall and results in nearly no food crop production in an area. Large evaporation resulting from poor water retention capacity of soil adds to the problem and even the availability of water for drinking purposes also gets affected and it leads to loss of life to people, cattle, other animals and birds also. Draught is a major problem in different parts of the world including India like some areas are worst affected by draughts viz. Rajasthan, Madhya Pradesh, Andhra Pradesh etc. Our government takes many steps to tackle the draughts by releasing various funds/grants and giving subsidies etc.

(c) **Famines :** Famines means non-availability of food to many people. It can be due to decline in the availability of food or some persons access to have food, i.e. it affects poor people the most. Earlier, famines were meant by reduction in food production but now where there is availability of food but people cannot take it like poor people cannot afford or are able to purchase food is also included in famines. Apart from extreme poverty, famines can result from many situations where food production process is declined like draught, floods, fires, heavy rainfall, etc. Our government tries to provide relief to famine victims also with its various victims.

2.1.9 Other Considerations

There are many considerations which can help in managing various disasters like :

(a) **Public Awareness and Training :** "Catch them Young" is a phrase used to create awareness among children, i.e. children should be made aware of the disasters by educating them and they should be invited to do various rallies, drawing competitions etc. to spread awareness on disaster issues. And even some summer workshops can be held to impart some basic awareness and training to help disaster victims like fire fighting, first-aid etc. Awareness in childhood can have benefits in the long run when children become adults and would be better prepared to

help our society and country with their interests developed in many respects related to disasters.

Even public awareness programmes for general public is also encouraged to handle disasters situations like first-aid, fire-fighting etc.

(b) **Policies of Government :** Government policies at various levels can be prepared and implemented. As our government does a lot to help in the crisis of disasters by issuing warnings, forecasting, releasing funds and grants, giving medical assistance, helping with the armed forces, and with various programmes, policies, NGOs also by providing them various grants, with many laws and regulations etc.

(c) **Media :** The role of media cannot be left out while tackling various disasters. As media can offer various roles that it is must for the handling of disasters. Media plays many roles in disaster management like it can create public awareness and training also with the help of newspapers columns or television programmes, or radio etc. It can educate masses at the same time. It helps to issue warnings in various areas where forecasting has been predicted for any occurrence of fire disasters. It reports the disasters in news so that those persons who want to help the victims can reach the disaster affect areas at the earliest, etc.

(d) **Disaster Preparedness Plans :** Disaster preparedness plans can be made to design and minimise the loss done by disasters. These can include forecasting, issuance of warnings, timely help to victims, rehabilitation of persons etc. and even public awareness and training can also be included. These can be short-term and long-term as well.

Short-term plans are based on past occurrences of the disasters and giving immediate help to disaster victims at the earliest time possible is included by giving emergency help of medical assistance, saving the lives, giving food, shelter, water, etc.

Long-term plans include the rehabilitation of the disaster victims by releasing various funds & grants and even creating public awareness and education are part of it.

The plans can be at various levels like central, state, district etc. Even the involvement of various departments and NGOs are also to be considered in these plans.

(e) Food Supplies : During disasters, these can be various modes for transportation of the food supplies like rail transport, air transport, road transport etc.

2.1.10 Conclusion :

Although some disasters occur for a very short time but they leave long lasting effects to the victims who are survived but has lost their near or dear ones or their earning opportunities. And it is beyond human control to stop or prevent the occurrence of disasters especially the natural ones. But even terrorists acts are also beyond our control as they are also occurring simultaneously although our government are sometimes able to stop and prevent some of the terrorist acts. But disasters disrupt the normal life of many people so we should be prepared to manage the disasters and we all should do something to help the victims. Even in our smallest help we can help many ones like by donating money, food, clothes or personal help also. And we can even help in creating public awareness and training too.

2.1.11 Suggested Questions

1. What are disasters?
2. Discuss any three :
   - (a) earthquakes
   - (b) floods
   - (c) cyclones
   - (d) landslides
   - (e) snow avalanches
3. Explain the role of media in disaster management.
4. Prepare a disaster management plan for your district in the case of floods.

2.1.12 Suggested Readings

1. Text book of Environmental Studies - Dr. K. Raghavan Nambiar
2. Environmental Studies - R.R. Dass
3. Environmental Studies - R. Rajagopalam
4. Environmental Education - R.A. Sharma

Lesson No. 2.2 **Author : Amita Kaistha**

Social Issues and the Environment

[Water conservation, Rain water harvesting, watershed management, Resettlement & rehabilitation of people; climate change, global warming, Acid rain, ozone layer depletion, nuclear accidents & holocasts, wasteland reclamation, need for public awareness, consumerism and waste products.]

Structure:

2.2.1 Introduction

It is true that ecological balance and ecosystem stability are duly maintained by nature itself but the modern, scientific, technological and industrial developments have disturbed the ecological balance and ecosystem stability through heavy industrialization, technological revolution, faster growth of means of transportation and communication, rapid exploitation of nature resource, large scale land use, unplanned expansion of urban population and industrial complexes. Thus, human activities of modern man have disturbed the natural and harmonious relationship between man and environment. There is a need to employ the concept of Environmental management to maintain the ecological balance and stability of ecosystem. Environmental management involves socio-economic development of the society on the one hand and maintenance of 'environmental quality' on the other hand. This objective can be achieved through check on destructive activities of man, conservation, protection, regulation and regeneration of nature.

In this chapter we will discuss certain environmental issues as well as social issues related to the environment so as to make people aware about environmental management.

2.2.2 Objectives

After going through this lesson, students will be able to:

1. Understand the concept of sustainable development.
2. Discuss urban problems related to energy.
3. Explain water conservation. Rainwater harvesting and watershed management.
4. Describe problems related with resettlement and rehabilitation of people because of various natural calamities and human projects.
5. Recognise the need of wasteland reclamation.

6. Understand the concept of climate change, global warming, acid rain and ozone layer depletion.
7. Describe the concept of consumerism and waste products.

2.2.3 Water Conservation, Rain Water Harvesting, Watershed Management

2.2.3.1 Water Conservation

Water shall be the main bone of contention in the future world conflicts. Irrigation uses the largest percentage of the available water, followed by industries. Then come domestic and commercial demands. Pollution of fresh water is the major threat that puts great constraints on water availability and use.

Irrigation/agriculture: About 70% of the water is used in agriculture and irrigation. Conservation can be done by providing impervious lining. By doing so about 25 to 35% of water can be saved. Proper drainage must be provided and this water must be recycled. This saves the land from water logging and salinization. For several crops, drip irrigation, sprinkler irrigation and fogging can be used and a large quantity of water saved. About 60% of water is saved by drip irrigation. During rainy periods, irrigation water must be cut off. Partly or fully treated sewage can be used for irrigation. Such practices conserve water that is in short supply.

Industry: Industries are innately water intensive. As an example 300m^3 of water is required to pro-duce 1 tonne of steel. Our technology needs revision and revamping so as to reduce water usage. In cement industry dry process instead of wet process saves quite a large quantity of water.

Domestic and municipal: Leakage accounts for 10% loss in India. Though we are supposed to use as little as 135 lit/capita/day, several developed countries use up to 1000 lit/capita/day. Still we are unable to supply fresh water to 100% of the population. Flushing of toilets is another activity that accounts for large wastage of water. So by adopting flush tanks of 2. to 5 lit capacities instead of conventional 10 lit capacity tanks a lot of water can be saved. Waste-not pipes have to be used. Segregation of sewage and sullage at the origin can facilitate us to use sullage for gardening and other secondary uses. This also conserves water. Rain water harvesting has to be promoted. Illegal taping and theft accounts for 10% of water loss. This has to be curbed by strict vigilance and legislation.

2.2.3.2 Rainwater harvesting

This method has been widely adopted in Gujarat and Rajasthan. However, Tamil Nadu Government took a bold decision to institute rain water harvesting as mandatory requirement in building rules. Now Kerala Government also has made water harvesting a compulsory requirement in each and every building. This method is now being adopted throughout out country and abroad. Australia, Caribbean Islands, Lakshadaveep and Hong Kong are other areas where water harvesting is adopted widely and successfully.

During heavy rainfall the surface water goes as runoff and gets wasted. This occurs because man has removed the vegetation and grass from the land and replaced them by hardened pavements, roads and courtyards. As a result the water does not have an opportunity to percolate into the ground and replenish the ground water. However, exploitation of ground water goes on uninterrupted. This has lowered water table by hundreds of meters. More over the quality also has deteriorated. It is in order to prevent these maladies that rain water harvesting has been recommended. In Chennai, during the last 4 years ground water level has risen and the quality also has improved considerably. The rain water harvesting can be done on a large scale in a water shed. In the case of building, it can be done so as to obtain sufficiently high quality water.

In the case of multi storeyed building this water is either collected in tanks or permitted to replenish the ground water table. There is yet another method in which ditches are cut along the contours of a slopping terrain ditches and filled with coir or coconut husk and planted with wild plants. The run off during torrential rains are prevented to flow easily. The water is interrupted by green belt growing on either side of the ditches. The ditch can be 1 to 2m wide and 1m deep. Soil erosion and water losses are prevented and ground water is replenished. This was the method proposed by the author in VLB Janakiammal College of Engineering & Technology, Coimbatore, Tamil Nadu.

2.2.3.3 Watershed Management

Water loss can also be prevented by certain good agricultural practices. They are:

- Growing luxuriant vegetation on slopes and adopting no ploughing cultivation during the rains.
- Spreading and retaining crop residues on the fields.

- Provision of contour ditches shall prevent water loss.
- Contour plantation of wild shrubs, grass and trees.
- Construction of small check dams across rivulets.
- Maintaining of wetlands like marshes and bogs as such.

2.2.4 Resettlement & Rehabilitation of People; its Problems and Concerns

2.2.4.1 Resettlement & Rehabilitation of People

Resettlement and rehabilitation become necessary when human habitats are destroyed by natural calamities like tsunami, earth quake, mud flows or tidal waves. People are forced to go out during reservoir filling or other developmental stages of projects. Large reservoir projects have been the forerunners in displacing several millions of people. Sardar Sarovar Dam in Narmada Valley Project, Tehri dam Project in Garhwal are a few cases where rehabilitation has become a controversy. About 35,000 people are yet to be rehabilitated in Sardar Sagar Project. It is said that over a million people will be displaced if all the dams in this megaproject are completed. Aswan high dam has displaced many thousands, besides drowning many scenic spots, historical sites, temples and fertile lands. The Three Gorges Dam in Changsjiana river shall displace a million people, inundating 150 cities and villages.

As for natural disasters like earth quakes and tsunami there are several examples in India and several hundreds in the world. The earthquakes of Gujarat and Latur in Maharashtra and Tsunami in Tamil Nadu, Kerala and South Asia, Cyclones in Andhra Pradesh Tamil Nadu and Orissa are natural calamities which have left many thousands of peo-ple homeless. There are also problems that render millions homeless and rehabilitation becomes obligatory.

Immediate rehabilitation of the people on temporary scale is the first step. Appropriate places should be chosen above maximum flood level and earth quake free area and quake and storm resistance structures have to be designed and constructed. Latur is a typical example of good rehabilitation programme. The uprooted people should be provided with all community infrastructures for a happy life. Disaster Management Committees exist at all levels: However, they are dormant, ineffective, inefficient and uncommitted to the cause of their own brethren. The major malady is monetary constraints and sometimes the lack of it.

2.2.4.2 Case study

Rehabitation in reservoir projects: Narmada Water Disputes Tribunal (NWDT) have stipulated among other things. The acquisition of lands that may be submerged and settings compensation resettlement and rehabilitation of the evicted people. Accordingly, every displaced family from where more than 25% of its land holding has been acquired are entitled to irrigable land of its choice to the extent of land acquired with a rating of 2 ha per family. All persons affected by the project irrespective of whether they are land owners or landless and their major sons shall be entitled to a house plot of 502m^2 free of cost besides a grant of Rs.750/-. Individual and community benefits at places of new resettlements shall be available to others. For all the displaced families Gujarat Govern-ment shall provide facilities for their settlement. Those of the displaced persons, who do not wish to settle in Gujarat, shall be accommodated by the Governments of Maharashtra or Madhya Pradesh.

Rehabitlation 'of displaced tribals becomes a real problem in several project areas. Several irrigation and power projects have created such problems. The case of Narmada Valley Project assumes significance. In the case of Sardar Sarovar Project it is not only tribals, but people engaged in agriculture and fishing are affected. Many hundred of families living on the banks of the river are uprooted and displaced. They lose their employment opportunities and have to starve. According to the CSS, the objectives of rehabitation should be:

- The people displaced should get an appropriate share in the fruits of development.
- They should be rehabilitated by creating new settlements within their own environment.
- Removal of poverty should be an objective of the rehabilitation policy.
- All of them should be employed.

2.22.5 Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion

2.2.5.1 Climate Change

Scientific and industrial revolution during the past over a century have been responsible to bring more and more comforts for men but this has also been responsible to cause wide range of environmental changes. The climatic change can be of two types. The first is natural phenomenon which occurs on a geological

time-scale and is a beyond human control. The second is human induced changes. It is this type of change which is our present concern. These changes are brought about through industrial and vehicular emissions into the atmosphere causing changes in the composition of atmosphere.

2.2.5.2 Global Warming

The solar radiation impinging upon the surface of the earth passes through a thick blanket of atmosphere. The radiation is a part of the electromagnetic radiation which consists of wavelength starting from 10^{-14} cm to 10^{6} cm. The solar radiation consists of wavelengths from 10^{6} cm to 10^{-1} cm. The visible range is limited to 380 nm to 775 nm. The air as well as earth absorbs the incoming radiation and remit it. The remission always takes place in longer wavelengths than the radiation absorbed, thus, remitted radiation is heat radiation (infra-red). The thick atmospheric layer is transparent for short wave radiation but certain gases absorb long wave radiations increasing the temperature. The outermost layer of the atmosphere consists of a thin layer of ozone which absorbs all ultra-violet radiations and hence they do not reach the earth's surface.

The main atmospheric gases responsible for the absorption of heat and consequent warming are carbon dioxide; emitted by the burning of fossil fuels and biomass. Its concentration increases due to non -utilization by the plants reduced due to reduction of vegetal cover due to deforestation. Carbon dioxide is even today the most important gas responsible for warming- to the extent of 50 per cent. Methane is the second gas contributing to warming by 18 per cent. It is obtained as a result of anerobic digestion of organic matter in biogas plants and waterlogged paddy fields. The next important gas is chlorofluoro-carbons escaping from refrigeration units and also the halones obtained from fire fighting equipments, these contribute about 18 per cent warming of the atmosphere. The next one is nitrous oxides which has about six per cent contribution towards warming.

Methane traps heat about 25 times more than carbon dioxide and CFCs about 10,000 times more heat trapping capacity than carbon dioxide. These gases act in the same manner as the glass-houses made in temperate regions. These are called greenhouses. The heating within these greenhouses are caused due to the property of glass which is transparent for light but not so for the heat radiations and hence the remitted radiations get locked up in these greenhouses

and thus get heated up. Similar action depicted by atmospheric gases is been called' as greenhouse effect. The gases causing such effect in atmosphere have, therefore, been called greenhouse gases.

2.2.5.3 Acid Rain

"Acid rain" is a much wider term including rain, snowfall, fog and dew having more acidic reaction than the normal. The oxides of carbon, sulphur and nitrogen present in the air react with water vapour in presence of sunlight and produce carbonic acid, sulphuric acid and nitric and nitrous acids. These acids remain in vaporous state and gradually condense with falling temperature and produce acid rain. Acid rain has the potential of being widely distributed. The sulphur and nitrogen compounds formed by the burning of fossil fuel can be blown through long distances, even thousands of kilometers. Thus the acid rain may occur in countries far from their origin. It is thus an international nightmare, it can also be called as an undeclared chemical war.

2.2.5.4 Ozone Layer Depletion

Ozone is a gas having three atoms of oxygen making a molecule O_3. This acts as a protective shield by not allowing ultra-violet radiations (less than 300 nm) to enter in the atmosphere. The ozone is formed by photo-chemical conversion of oxygen. This reaction normally takes place at higher altitudes of the atmosphere. The thickness of the ozone layer is not uniform throughout the world.

Due to the quality of ozone to absorb the short wave radiations i.e., below 300 nm it is capable of protecting the living organisms from the harmful effects of these radiations. In human beings these radiations are believed to cause skin cancer, cataract of eye, damage immune systems and finally cause death. It has also been shown to cause damage to crops, forests and other natural systems. The depletion of ozone layer causing "ozone holes" a perceptible reduction in the thickness of this layer especially in the Antarctic and probably in the Arctic zone have been observed. It has been observed that ozone layer is depleting now at much faster rate than earlier and the ozone hole has grown by about 50% since 1979 when they were first observed. Over a major part of Indian subcontinent the ozone content is already much lower, hence, the ultra-violet doses are higher.

Modern man has been using deadly chemicals like chlorofluorocarbons (CFCs) and halogens which destroy ozone layer. CFCs are used as propellants in aerosol

sprays, coolants for refrigerators and air-conditioners, manufacture of plastics, insulating foams for buildings and packaging materials. CFC molecules moving up in the atmosphere, under the action of solar, radiation are broken up releasing active chlorine. This active chlorine combines with ozone producing oxygen molecule and chlorine monoxide. Chlorine monoxide further disintegrates into chlorine and oxygen. This released free chlorine atom again undergoing the same reaction to keep the cycle going.

So, it is clear that the degradation of ozone takes place by the free chlorine atom and chlorine monoxide in its own turn again produces free chlorine atom and water molecule by combining with free oxygen atom. This cycle goes on at higher altitudes where free oxygen atom and ultra-violet radiations are available. Besides disintegrating the ozone this cycle utilizes the free oxygen and thus hampers the formation of ozone molecule thus can rapidly deplete the ozone layer.

An international cooperation was agreed in Vienna in March 1985 to fight the threat of ozone layer and a protocol to that effect has been signed by 40 countries on 16th September 1987 in Montreal. This is commonly known as Montreal Protocol. The protocol envisages the restriction of global emission of CFCs to 50% of 1986 level. The protocol has asked the developed countries to reduce the consumption of CFCs by 50% by the year 2000. The consumption of CFCs in developed countries is 1 kg per capita per year. In India the consumption is 0.005 per capita per year. The protocol envisages that per capita consumption be brought to 0.3 kg per capita per by the year 2000 and to 0.005 kg. kg per capita per year by the year 2006.

2.2.5.5 Nuclear Accident

On 26th April, 1986, at 1.23 hours one of the four operating reactor units at Chernobyl Nuclear Power Station's fuel element suddenly ruptured into minute very hot pieces causing steam explosion. The energy released by this explosion was so enormous that it blew 1000 ton cover plate of the reactor, cutting all the cooling channel. This was followed by another explosion ejecting hot pieces of reactor from the damaged buildings. The graphite used as moderator in the reactor started burning. This fire extensively damaged the reactor building, equipments reactor including its core.

This accident caused damage to domesticate as well as farm animals. Besides loss to living beings there were irrepairable cultural losses like the icons of Middle Ages,

damage of newly built library at Pripyat housing priceless treasures of knowledge.

The trees in an area of 30 km radius from the power plant got seriously contaminated and its burning would have resulted in the spread of air borne contamination. Whole forest had to be cut down and burried. Heaviest casualties occurred amongst the fire fighters or "liquidators" at the Chernobyl Nuclear Power Station. Nearly one million liquidators were conscripted and it is estimated that 8,000 to 10,000 are now dead in Ukraine alone. In addition to the liquidators about 15.6 million persons exposed to this disaster suffer from various ailments. Children received 200 rads or more on their thyroid causing enlargement of lymph nodes besides changes in blood picture. Gastric and intestinal disorders in a large number of persons have also been reported.

2.2.6 Wasteland Reclamation

Wasteland is a lose term used to designate those land masses which have lost their productivity due to natural and/or anthropogenic reasons. These can be categorised as:

1. ***Natural wastelands.*** In hills, landslides are of common occurrence and these expose the soils which are low in their productivity potential. These can be checked by construction of drainage ditches and walls along hill slopes. An appropriately selected plantation of soil binding species shall also be helpful in preventing the soil erosion. The exposed soils after landslide can be rehabilitated by planting carefully selected plants on it. This will reclaim the land.

2. ***Anthropogenic wastelands.*** In the recent years -deforestation, large scale abuse of soils, use of chemicals, etc. have been responsible for the generation of large expenses of waste lands.

(a) Deforestation and abandoning the land after excessive agriculture removes all the soil binding vegetation. Such soils are washed always along with rain and running water. These processes are called erosion. Soil erosion can effectively be prevented through large scale plantation of trees, shrubs and grasses capable of binding the soil, and utilizing it for agriculture, horticulture, etc.

(b) Over cultivation deplete the soil of organic matter and nutrient has been responsible for the loss of fertility.

Water logging be avoided by sealing lateral seepages from water sources such as canals, tanks, ponds, etc.

Alkalinity and salinity of soil can be neutralised by the application of gypsum, phosphogypsum, pyrites, organic manures, etc.

The area may be used to grow salt and alkali resistant plants like cotton, date, palm, soya, millets, barley, and spinach.

(c) Human activities like large scale irrigation in course of time convert the area into waterlogged area.

(d) Dumping of solid wastes generated from industrial mining and residential areas are deposited on land. This causes generation of huge wastelands adjoining these areas. These areas can be reclaimed by planning plantation of carefully selected plants suitable for growth on dumped wastes.

2.2.7 Consumerism and Waste Products

Present social order developed under the influence of scientific and industrial revolution exhibits a variety of consumerisms. The present day affluent society's consumer behaviour results in environmental degradation at a large scale. Though such consumerism tends to improve the standard of living of the society but it is at the cost of such environmental changes which might make perpetuation of human beings difficult. The realization of this fact teaches man that with the power of science he can do anything he wishes is not correct. It prompts him to modulate his actions in the manner that they do not cause discomfort to others and are not likely to harm himself irrepairably (Burkley *et al.,* 1972).

The Western Culture developed under the influence of advanced technological outputs is a culture of 'use and through' consumerism. There is need to learn from the mistakes of the developed countries and take preventive measures well before the damage becomes irrepairable.

This scenario of consumerism is characterized by the production of wastes causing impact on the environment and making it all the more harmful for the survival and perpetuation of human beings. This in its own turn involves that any product made, packed, used and / or disposed off in a way that significantly does not cause the harm it would have otherwise caused to the environment. Such products have been called as Eco-friendly Product (EFP). These substances are not supposed to produce hazardous wastes; the wastes generated (are recyclable and biodegradable. The production of these materials are characterized

by low energy consumption. The concept of eco-friendly products and their use to harness sustainable development was first introduced in 1978 in Federal Republic of Germany. Later the concept has been introduced in Canada, Japan, France, Sweden, Finland, Iceland, Netherlands, USA, Korea, Singapore, and India.

Hayes (1990-91) has pointed out that environmental concern has direct influence upon policies of nation, law, education, religion, investments and consumer behaviour leading to the development of the lifestyle. It has also been pointed out that once proper awareness is provided to user; it may refuse, to purchase the goods having deleterious effect on the environment.

The Environmental Report Card is a new and easy to use tool designed to determine how well a product performs environmentally.

It must be remembered that all the commodities used by the consuming society place some burden on the environment at some stage during the life-cycle. The efforts must thus be made to eliminate or to reduce these burdens whenever possible as an act of real saving of the environment.

The Environmental Report Card provides cradle to grave, accurate, objective, commonly understandable environmental performance of the products under following heads:

Resource depletion

Water (Fresh)

Wood

Coal, oil, natural gas, gas (Non-fuel)

Matal ores

Other minerals

Food

Fibre *(e.g.,* cotton, jute, etc.)

Animal products *(e.g.,* leather).

Energy

Coal

Oil

Natural gas

Nuclear

Hydro.

Air pollution

Ozone destroying chemicals

Carbon dioxide

Carbon monoxide

Sulphur oxides

Nitrogen oxides

Particulate matter

Unclassified pollutants

Hazardous air pollutants.

Water pollution

Total solids

Oxygen depleting chemicals

Unclassified pollutants

Toxic pollutants

Solid wastes generated

Unclassified: Biodegradable

Non-biodegradable

Hazardous wastes.

Their quantities are given either in grams or in kilograms and the burden caused are shown from low to high by bars.

The card is useful to consumers, businessmen and government in the following manner:

Benefits to consumers

- empowers to make better informed decision regarding products;
- educates about the root cause of today's most serious environmental problems; and

- helps in identifying the best strategies for personal improvement.

Benefits to business

- Gives companies the flexibilities to choose materials and technologies to optimize product's eco-profit.
- Capable of registering incremental improvements as they occur.
- Effective universal label that can be used throughout the globe.

Benefits to government

- Provide an objective basis for "environmentally preferable" procurement programmes.
- Fosters industry improvements beyond compliance through marketplace incentives.
- The eco-labeling approach that does not inherently create barriers to trade.

In order to change the present consumerism pattern into consumerism of eco-friendly products following steps are suggested at consumer, industry and government levels:

Consumers

1. Total awareness towards use of eco-friendly materials.

Industry

2. Industry must take up the task of produce more and more eco-friendly materials.
3. Manufacturers must use the processes of production those are eco-friendly and have less environmental impact.
4. It must be ensured that the product's degradation products are less pollution causing.
5. Industry must ensure conservation of resources.
6. Reuse of packaging materials be ensured.
7. The industry must utilize local skills and resources.
8. Industry must provide full details on the Environmental Report Card attached to the product.

Government

9. The government must take steps to make it mandatory that all the products must have an Environmental Report Card.
10. A central coordinating agency be established to coordinate the eco-friendly activities of various states.
11. Independent state agencies be organised.
12. Incentives provided to the industries producing eco-friendly products..
13. Financial support be provided for generating awareness amongst people for use of eco-friendly products.
14. Use of information technology to popularise such products.

2.2.8 Need for Public Awareness

There is lack of awareness of the interrelated nature of all human activities and the environment due to inaccurate or insufficient information. There is need to increase public sensitivity to environment and development problems and involvement in their solutions and foster a sense of personal environmental responsibility and greater motivation and commitment towards sustainable development. There is need to promote public awareness as an essential part of global education effort to strengthen attitude, values and actions which are compatiable with sustainable development.

Public awareness of the environment means the ability to emotionally understand the surrounding world, including the laws of the natural environment, sensitivity to all the changes occurring in the environment, understanding of cause-and-effect relationships between the quality of the environment and human behaviour, an understanding of how the environment works as a system, and a sense of responsibility for the common heritage of the Earth, such as natural resources - with the aim of preserving them for future generations.

To know and understand what is good and what is better, and at the same time commit a wrongdoing, is socially more injurious than committing a wrongdoing in ignorance. Therefore, building, in a society, a new system of values with the aim of creating environmental public awareness, should include systematic training activities aimed at increasing the basic knowledge of ecology and environmental protection, and, at the same time, raising the sensitivity of individuals to nature.

Environmental public awareness comes from a result of general knowledge, specialist knowledge of a particular problem and also sensitivity to, and a sense of, responsibility for the environment.

Environmental public awareness is shaped throughout the whole life of particular people living in a given local community, performing specific work and having definite personal characteristics which have a deciding effect on their sense of responsibility and ability to emotionally perceive the environment as having value in itself. The knowledge acquired during school education and then systematically improved in adulthood, is an essential factor in heightening the enviornmental awareness of an individual and, at the same time, an indispensible condition for the development of a pro-ecological lifestyle. Public can be made aware through :

* Schools and academic manuals,
* messages transmitted through mass media,
* children, youth, daily, popular and specialist press,
* television and radio programmes,
* films, including documentary films,
* Internet,
* own experience and observations,
* work for organizations
* Organizing campaigns

It has also brought to the knowledge of common citizens of India that for sustaining agriculture and maintaining the quality of environment at least one-third of the country's land should be under forest. This public awareness has helped government as well as voluntary organizations to take up the issue of environmental protection. People and activists agitation in connection with Chipko Movement, Appiko Movement, Silent Valley (Kerala) and Sardar Sarovar Project on Narmada are some illustrations to show how to clean and make environment pollution free.

2.2.9 Summary

In this chapter we have discussed that a sustainable state is one in which utility is non-declining through time and in which resources are managed so as

to maintain production opportunity for the future. For an integrated energy management system we should have renewable energy as well as non-renewable energy sources. We also have discussed water conservation, rainwater harvesting and wasteland management.

Resettlement and rehabilitation become necessary when human habitats are destroyed by natural calamities like tsunami, earthquake, mud flows or tidal waves. The history of earth reveals that gradual climate change has continuously occur due to natural phenomena and human induced changes which leads to global warming, acid rain, and ozone layer depletion. Wasteland is a term used to designate those land masses which have lost their productivity due to natural and anthropogenic reasons. The present day affluent society's consumer behaviour results in environmental degradation at a large scale. Through such consumerism tends to improve the standard of living of the society but it is at the cost of such environmental changes which might make perpetuation of human beings difficult.

2.2.10 Key Concepts

1.	Sustainable	:	That may be sustained or kept up
2.	Renewable	:	Which can be renewed after a period of time.
3.	Resettlement	:	means proper arrangement not only for habitation & Rehabilitation of people but also for their vacation as well as employment.
4.	Ozone	:	It is a gas having three atoms of oxygen making a molecule O_3.
5.	Wasteland	:	A land which has lost its productivity due to natural or anthropogenic reasons.

2.2.11 Suggested Readings and Web Sources

1.	Text book of Environmental Studies	-	Dr. K. Raghavan Nambiar
2.	Environmental Studies	-	R.R. Dass
3.	Environmental Studies	-	R. Rajagopalam
4.	Environmental Education	-	R.A. Sharma

Web Sources:

1. www.globalissues.org 2. edugreen.teri.res.in
3. en.wikipedia.org

2.2.12 Suggested Questions

1. Give brief note on water harvesting.
2. What are the green house gases and their impact on global temperature?
3. What are the ozone depleting chemicals and their impact on ozone layer?
4. Give a brief account of resettlement and rehabilitation of displaced people.

2.2.13 Self Check Exercise

Fill in the blanks:

1. Global warming causes ..... in sea level.
2. Acid rain is caused by ..... .
3. The conference related to the control of chloroflurocarbon is called as.....
4. ..... gas has the maximum greenhouse effect.
5. Two sources of energy are ..... and ..... .

Answers:

1. Rise, 2. Nitrogen dioxide and Sulpur dioxide, 3. Montreal Protocol
4. Carbon dioxide 5. Renewable and non-renewable.

Lesson No. 2.3 Author : Ms. Ravneet Kaur

INTRODUCTION TO ENVIRONMENT PROTECTION LAWS IN INDIA

2.3.0 Objectives

The scope of this lesson is to familiarise you with the basic environmental laws and some other dimensions concerning environment. After studying this lesson, you will be able to understand :

- Environment Protection Act, 1985
- Air (Prevention and Control of Pollution) Act, 1981
- Water (Prevention and Control of Pollution) Act, 1974
- Wildlife Protection Act, 1972
- Forest Conservation Act, 1980

- Issues involved in enforcement of environmental legislation
- Environmental Ethics : Issues and Possible Solutions
- Public awareness

2.3.1 Introduction

Just think about a packet of potato-chips. When finished, many times it is thrown in the open if we are at a public place. But this action is different when we are inside our homes. This example shows that even with the same thing, people do behave differently.

Human activities, whether individual/organizational or commercial/ non-commercial, are indeed polluting the natural environment without any ethical concern that it is the nature which is furnishing our all needs.

Moreover, rapid industrialization has led to many environmental problems also, like acid rain, emitting noxious gaseous fumes and toxic effluents, etc. And much usage of chemical fertilizers and pesticides are contaminating the soil, water and air. So to safeguard against environmental pollution, many laws have been enacted in India to deal with various pollutions and other natural settings. But the enactment of laws is not an end in itself as there are problems also regarding their implementation and enforcement. So various issues in the enforcement of environmental legislation are also discussed in the present chapter. And in reality, the enforcement of laws depends upon their awareness in the public, hence public awareness for environmental legislation is also discussed in this chapter.

2.3.2 The Environment Protection Act, 1986

'The United Nations Conference on the Human Environment' was held at Stockholm in June 1972. India also participated in this conference. To implement the decisions of the UN conference and further with the incident of the Bhopal Gas Leak Tragedy in 1984; pressed the need of environmental legislation. Hence, in 1986, the Government of India enacted The Environment Protection Act, 1986. It should be kept in mind that many different laws or acts regarding environment were available before this enactment, but a need was felt for a comprehensive act to regulate and coordinate various environmental concerns. It does not mean that other acts are not needed and should be discontinued, but they are helpful in their own way and many amendments of other acts have

been done afterwards keeping in view, the Environment Protection Act, 1986. As the formation of the Environment Protection Act, 1986 is to plan and implement various safeguards to protect the environment. Hence, this act is sometimes referred to as an 'umbrella' legislation which empowers the Central Government to coordinate various central and state authorities like the Water Act and the Air Act.

Main Provisions of this Act

(1) Under Section 3, the Central Government has absolute powers to take any measure to protect and improve the quality of environment and also to preventing, controlling and abating environmental pollution. Some such measures are :

- Coordinating the actions of various state government officers and other authorities;
- to plan and execute a nation-wide programme;
- to lay down standards for the quality of environment;
- to lay down standards for emission or discharge of environmental pollutants;
- to restrict areas whose industrial operations and processes cannot be carried out or carried out with certain safeguards;
- to inspect any premises, plant, machinery, etc.
- to establish environmental laboratories;
- to collect and disseminate information regarding environmental pollution; etc.

(2) Under Section 5, the Central Government can issue directions for the closure, prohibition or regulation of any industry, operation or process; or the stoppage or regulation of the supply of electricity or water or any other service.

(3) Under Section-7, no person carrying out on any industry, operation or process shall discharge or emit or permit to emit to be discharged or emitted any environmental pollutant in excess of such standards may be prescribed.

(4) Penalties for contravention of the provisions of this Act are provided Under Section-15.

Under Section-15(1) whoever fails to comply with or contravenes any of the provisions of this Act, or the rules made or orders or directions issued thereunder, shall, in respect of each such failure or contravention, be punishable with imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees, or with both, and in case the failure or contravention continues, with additional fine which may extend to five thousand rupees for every day during which such failure or contravention continues after the conviction for the first such failure or contravention.

U/s. 15(2) if the failure or contravention referred to in sub-section (i) continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which may extend to seven years.

Note : The Act is silent on minimum imprisonment and fine.

(5) Under Sections 16 and 17, companies and Government Departments are also liable for offences, even the Head of the Department may be punished also.

(6) Section-19 : Cognizance of Offences

No court shall take cognizance of any offence under this Act except on a complaint made by :

(a) the Central Government or any authority or officer authorised in this behalf by that Government; or

(b) any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the Central Government or the authority or officer authorized as aforesaid.

(7) Section-24(2) is a loophole in this Act as it provides where any act or omission constitutes an offence punishable under this Act and also under any other Act, then the offender found guilty of such offence shall be liable to be punished under the other Act and not under this Act.

Note : The Environment Protection Act, 1986 also empowers the Central Government to make rules for carrying out the purposes of this Act and such rules are to be laid down before the Parliament for its approval.

There are many rules which have been made by the Central Government like :

(1) The Environment (Protection) Rules, 1986, which contain many aspects like setting-up of standards and limits of various levels of pollution viz. standards for emission or discharge of environmental pollutants. Different standards have been prescribed for different industries, processes etc.

(2) The Hazardous Wastes (Management and Handling) Rules, 1989.

(3) The Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996.

(4) Noise Pollution (Control and Regulation) Rules, 2000 and many more.

2.3.3 The Water (Prevention and Control of Pollution) Act, 1974

Although water is a state subject, this act was enacted under Article 252(i) of the Constitution. Initially, it was implemented in few states but now all states have implemented it but the amendment of 1988 has not been adopted by all the states.

Major Provisions of this Act

(1) Three types of Boards can be established :

(a) Central Board U/s. 3 to be called as Central Pollution Control Board;

(b) State Boards U/s. 4 to be called as State Pollution Control Board; and

(c) Joint Boards U/s. 13 by :

(i) by two or more Governments of contiguous states, or

(ii) by the Central Government (in respect of one or more Union Territories) and one or more Governments of states contiguous to such union territory or union territories.

(2) Functions of Central Board - Section 16

(a) to promote cleanliness of streams and wells; (b) to advice Central Govt. regarding water pollution; (c) to coordinate activities of State Boards; (d) providing

technical assistance and guidance to State Boards; (e) giving training to persons; (f) mass media coverage programmes; (g) collecting and publishing technical & statistical information and preparing codes, manuals etc. for disposal of sewage and trade effluents; (h) to establish laboratories; (i) to perform functions of any State Board as specified; (j) to lay down standards; etc.

(3) Functions of State Board - Section 17

A State Board also performs above functions but advises the respective State Govt. and collaborates with the Central Board for some matters.

(4) Powers of a State Board

(a) Power to obtain information U/s. 20; (b) Power to take samples U/s. 21; (c) Power of entry and inspection U/s. 23; (d) to prohibit use of stream or well for disposal of polluting matters U/s. 24; (e) to make restrictions on new outlets and new discharges U/s. 25; (f) industries etc. have to inform State Board for certain matters of pollution discharges; etc.

(5) Under Section-33 a Board has power to go to courts for restraining apprehended pollution of water in streams or wells and a Board can even recover expenses for removing pollution disposals from the concerned persons.

(6) A Board U/s. 33-A can give directions for closure, prohibition or regulation of any industry; operation or process; or to stop electricity, water and any other service also.

(7) Penalties : There are different penalties for different offences under this Act like :

(a) U/s. 41(i), imprisonment upto 3 months or fine of Rupees Ten Thousand or both; for failure to comply with directions within time given U/s. 20(2) or (3); and additional fine of upto Rupees Five Thousand per day during which such failure continues after conviction for the first such failure.

(b) U/s. 41(2), imprisonment for minimum one year and six months and can be extended to six years and with fine, and if failure continues, then with additional fine of rupees five thousand per day during which such failure continues after the conviction for the first such failure.

(c) U/s. 41(3), imprisonment of minimum two years to seven years and with fine, for failure referred U/s. 41(2) continues beyond a period of one year after the date of conviction.

(d) U/s. 42(1), imprisonment of upto three months or fine upto rupees ten thousand or both, for certain acts like - destroying, damaging etc. any works or property of the Board or under its authority; failing to provide information; failing to intimate accidents etc.; giving false information; etc.

(e) U/s. 42(2), imprisonment upto three months or with fine upto rupees one thousand or both, for knowingly or wilfully altering or interfering with meter, gauge, other monitoring device so as to prevent from monitoring or measuring correctly, used for taking grant of consent U/s. 25 and 26.

(f) U/s. 43, imprisonment of minimum one year and six months but upto six years and with fine, for contravention of provisions of Section-24.

(g) U/s. 44, imprisonment of minimum one year and six months but upto six years with fine, for contraventions of Sections 25 or 26.

(h) U/s. 45, enhanced penalty after previous conviction of minimum two years but upto seven years and with fine, on second and every subsequent conviction, for contraventions done earlier and again found guilty under Sections 24, 25 or 26.

(i) U/s. 45-A, for contravening any provisions of this Act or failure to comply with orders or directions, for which no penalty has been elsewhere provided in this Act, imprisonment of upto three months or fine upto rupees ten thousand, or both. And in case of continuing failure, additional fine upto rupees five thousand per day during which such failure or contravention continues for the first such contravention or failure.

(8) Under Section-46, names of offenders can be published alongwith address, offence and penalty in newspapers or other manner, if any person convicted of an offence under this Act commits a like offence afterwards and it shall be lawful for one court before which the second or subsequent conviction

takes place. And expenses for publication are treated as fine and recovered from the offender.

(9) Under Sections-47 and 48, companies and Govt. Departments are also liable for offences made and even the Head of Department can be held liable personally also.

(10) Under Section-49(i), no court can take cognizance of any offence under this act except on a complaint made by -

(a) a Board or any officer authorized by it; or

(b) any person who has given notice of not less than sixty days in prescribed manner to the Board or its authorized officer; and no court inferior to that of a Metropolitan Magistrate or a Judicial Magistrate of the first class shall try any offence under this Act.

(11) Under Section-51, the Central Government can establish a Central Water Laboratory.

(12) Under Section-52, a State Government can establish a State Water Laboratory.

(13) Under Section-61, the Central Government has power to supersede the Central Board and Joint Boards in certain cases.

(14) Under Section-62, a State Government has power to supersede the State Boards in certain cases.

(15) Under Section-63, the Central Government has power to make rules in collaboration with the Central Board, if any, and these rules are to be laid down before Parliament for its approval.

(16) Under Section-64, a State Government has power to make rules in collaboration with the State Board, if any.

2.3.4 The Air (Prevention and Control of Pollution) Act, 1981

This Act is enacted on the lines of decisions taken at the UN conference in 1972 in which India participated.

Major Provisions of this Act

(1) Under Section-3, Central Pollution Control Board as constituted U/s. 3 of Water (Prevention and Control of Pollution) Act, 1974, shall perform all

functions, i.e. only one Central Board performs functions for water and air pollution.

(2) U/s. 4, similarly, State Pollution Control Board (as constituted under Water Act) is to perform functions for air pollution also.

(3) U/s. 6, in case of Union Territories, only the Central Board applies.

(4) Functions of Central Board U/s. 16

(a) to advise Central Govt. regarding improving the quality of air and the prevention, control or abatement of air pollution; (b) to plan & execute nation-wide programmes; (c) to coordinate various State Boards; (d) to provide technical assistance & guidance to State Boards; (e) to train persons; (f) to collect and publish data and prepare codes, guidelines etc.; (g) to lay standards; (h) to establish laboratories; etc.

(5) Functions of State Boards U/s. 17

To coordinate with Central Board and other similar functions of Central Board.

(6) U/s. 18, the Central and State Boards are bound to comply with directions issued by Central and State Govt. respectively.

(7) Powers of State Boards and State Govt.

(a) U/s. 19, the State Govt. in consultation with State Board can declare air pollution control areas; (b) U/s. 20 power to lay down standards for emission of air pollutants; (c) U/s. 21 power to make restrictions on use of certain industrial plants, i.e. no industrial plant can operate without previous consent of the State Board in an air pollution control area; (d) persons carrying on any industry etc. should not allow emission of air pollutants in excess of standards laid down by State Board; (e) U/s. 22-a, State Board can go to courts for restraining air pollution practices; (f) U/s. 24 power to enter and inspect; (g) U/s. 25 power to obtain information; (h) U/s. 26 power to take samples of air or emission; (i) U/s. 28 to establish State Air Laboratory; etc.

(8) U/s. 31-A, a Board has power to close, prohibit or regulate any industry, operation or process; or to stop or regulate supply of electricity, water or any other service.

(9) Penalties

Offence	Penalty
U/s. 37(1)	

(a)	Failure to comply with Sections 21, 22, or 31-A	Imprisonment of minimum one year and six months but upto six years and with fine; and if failure continues, additional fine of upto rupees five thousand per day after the conviction for the first failure.

(b) U/s. 37(2), if failure U/s. 37(1) continues beyond one year, minimum imprisonment of two years but upto seven years and with fine.

(c) U/s. 38, penalties for certain acts like - damaging property etc. under the Board; giving false information; etc., upto three months imprisonment or with fine of upto rupees ten thousand or both.

(d) U/s. 39, for other offences not mentioned elsewhere in this Act, upto three months imprisonment or fine of upto rupees ten thousand or both. And in case of continuing contravention, additional fine upto rupees five thousand per day during which such contravention continues after conviction for the first such contravention.

(10) Companies and Govt. Departments can also be held liable for offences done under this Act and even Head of Department can be punished also.

(11) U/s. 47, State Govt. has power to supersede State Board.

(12) U/s. 53 Central Govt. has power to make rules and get it approved from Parliament.

(13) U/s. 54 State Govt. has power to make rules.

2.3.5 The Forest Conservation Act, 1980

This is an Act to provide for the conservation of forests and for matters connected therewith or ancillary or incidental thereto. It was amended in 1988.

Section-2 imposes certain restrictions on State governments or other authorities on the preservation of forests or use of forest land for non-forest purpose. That is without the approval of the Central Government, the following orders cannot be passed by State Governments :

(i) that any 'reserved forest' in a 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 purpose; (iii) that any forest land may be leased to any private person or to organization, authority etc. not owned, managed or controlled by Government; (iv) that any forest land may be cleared of trees which have grown naturally in that land or portion, for one purpose of using it for re-afforestation.

Note : 'Non-forest purpose' means the breaking up or clearing of any forest land or portion thereof for : (a) the cultivation of tea, coffee, spices, rubber, palms, oil-bearing plants, horticultural crops or medicinal plants; (b) any purpose other than re-afforestation, but does not include any work relating or ancillary to conservation, development and management of forests and wildlife, namely, the establishment of check-posts, fire-lines, wireless communications and construction of fencing, bridges and culverts, dams, water-houses, trench marks, boundary marks, pipelines or other like purposes.

U/s. 3, the Central Govt. may constitute an Advisory Committee.

U/s. 3-A, whoever 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.

U/s. 3-B, the authorities or Govt. departments can also be held liable for any offences done.

U/s. 4, the Central Govt. has power to make rules and these to be laid before Parliament for its approval.

2.3.6 The Wildlife Protection Act, 1972

This Act ensures ecological and environmental security to wild animals, birds, plants and their habitats. Originally this Act was enacted under Article 352 of the Constitution and few states passed the resolution. But in 1976 'Protection of Wild Animals and Birds' was transferred to the Concurrent List (from State List) by 42nd Constitution amendment. Hence, the Wildlife (Protection) Amendment, 1991 extended it to whole India except Jammu & Kashmir. It was amended in 2002 also.

Major Provisions of this Act

(1) U/s. 3, the Central Govt. may appoint a Director of Wildlife Preservation and other officers and authorities also.

(2) U/s. 4, State Govt. can appoint Chief Wild Warden, Wildlife Wardens, etc.

(3) Section 5-A requires the Central Govt. to constitute the 'National Board for Wild Life' as amended in 2002.

(4) U/s. 6 State Govt. also has to constitute a 'State Board for Wild Life' as amended in 2002.

(5) State Board advises to the State Govt. U/s. 8.

(6) U/s. 38-A, the Central Govt. can make the Central Zoo Authority; and to establish a zoo, this Authority's prior approval is necessary U/s. 38-H (1-A).

(7) Hunting of wild animals is prohibited U/s. 9, but can be allowed in certain cases like when an animal becomes dangerous to human life, or disabled or diseased beyond recovery, etc.

(8) U/s. 11 killing or wounding any wild animal for defence of oneself or another person is not an offence.

(9) U/s. 12 the Chief Wild Life Warden may permit hunting of any wild animal (on payment of fees) in certain cases like - education, scientific research, to take snake venom for making life-saving drugs, etc.

(10) U/s. 17 no person can damage, destroy, wilfully pluck etc. any specified plant, and even nobody is allowed to sell, transfer etc. these plants. However, members of scheduled tribe are allowed for picking, collecting or possessing these plants for bonafide personal use in the district he resides. And for education, research, etc. purposes the Chief Wild Life Warden may permit anyone, with the permission of State Govt., to pick, collect etc. any plant.

(11) U/s. 18 State Govt. can notify an area as a sanctuary.

(12) U/s. 37 State Govt. can prohibit hunting in an area which is notified as a closed area.

(13) U/s. 27(1) there is restrict of entry in a sanctuary except public servants on duty, those who are permitted by Chief Wild Life Warden, etc.

(14) U/s. 35(4) State Govt. can notify an area as National Park.

(15) U/s. 44 no person can deal in trophy and animal articles without licence.

(16) Penalties for Offences U/s. 51

(a) Imprisonment upto three years or fine upto twenty five thousand rupees,

or both, for offences done under this Act, except some exceptions provides in this Act.

(b) Imprisonment of minimum three years but upto seven years and also with fine of atleast rupees ten thousand, for offences committed in relation to animals specified in Schedule-I, or Part-II of Schedule-II, or meat, trophy etc. of any animal, or offence done in a sanctuary or a National Park. Some penalty for contravening any provision of Chapter V-A of this Act.

(c) Atleast three years imprisonment or but upto seven years and also with fine of atleast rupees twenty five thousand for second or subsequent offences.

(d) Upto six months imprisonment, or fine upto two thousand rupees, or both, for contravening provisions of Section 38-J of this Act. And for second and subsequent offences, upto one year imprisonment or fine upto rupees five thousand.

(e) Also any animal, meat, vehicle and weapons used etc. for offences shall be forfeited by State Govt. and licence or permit etc. including Arms Licence shall also be cancelled.

(f) U/s. 52 the attempt or abetment to commit an offence is treated as contravention of the provisions of this Act.

(17) U/s. 55 no court shall take cognizance of any offence against this Act except on the complaint of following persons :

(a) Director, Wild Life Preservation; (b) Chief Wild Life Warden; (c) persons authorized by Govt.; (d) any person who gives atleast sixty days notice in prescribed manner to appropriate persons or governments.

(18) There is also a provision in this Act that a person shall not be punished twice for a same offence. Hence, the higher punishment provided under any other law can be awarded to the offender for an offence under this Act and simultaneously under any other law, if he is prosecuted under the other law.

(19) U/s. 63, Central Govt. has power to make rules.

(20) U/s. 64, State Govt. has power to make rules.

2.3.7 Issues involved in Enforcement of Environmental Legislation

There are many issues in the enforcement environmental legislation. Although legal statues and legal remedies are available but we have to fight for justice in a democracy to enforce legal legislations. And going to courts in itself is a long and cumbersome process. Some such issues are discussed below alongwith legal remedies that can be sought after.

(1) Lack of Public Awareness : Laws may have been made in totality but we must be aware of these to enforce them. The topic of public awareness is dealt with in the next section.

(2) Corruption : Although corruption is a major problem but in case of environmental safety and prevention or control of pollution, there is a lack of government checks and raids and also in the polluting premises much technical staff is not available who can handle environmental problems, emergencies, collect technical data of pollutants, etc.

(3) Urbanisation : Sometimes in the name of urbanization, some alterations are made in the original development plans.

A famous case on this issue is 'Bangalore Medical Trust V/s. B.S. Muddapa, 1991'. In this case, a land was allotted to build a hospital, but this land was meant for a public park as per the plan of Bangalore Development Authority. And our Hon'ble Supreme Court elaborated on the importance of parks and stopped the construction of the hospital by cancelling the allotment. As Supreme Court commented, "A private nursing home cannot be a substitute for a public park."

So a question arises what do we want? Here it is to be seen that its not that hospitals are not needed but a land reserved for a park should not be utilized for other purposes keeping in mind the environmental development of our country.

(4) Unplanned Industrialization : Rapid industrialization has led to setting up of even hazardous industries in various public localities. But these industries cause environmental pollution also.

A famous case in this regard is M.C. Mehta V/s. Union of India, 1987 (Uleum Gas Leak Case). As a result of gas leakage in Delhi, many people got affected. And many issues arose in this case like, (a) if the factory

gets closed then its thousands of employees would become unemployed, (b) the factory supplies chlorine to Delhi Water Supply, then from where to get it, etc. But Hon'ble Supreme Court ordered heavy compensation to the claimants and the company relocated many of its plants on the P.I.L. filed by M.C. Mehta, an environmental lawyer.

Note : We are indebted to M.C. Mehta for fighting many cases relating to environment in India like Taj Mahal case, Vehicular Pollution Case, Ganga Pollution case, etc.

(5) Availability of Legal Remedies :

(a) PIL (Public Interest Litigation) : A PIL can be filed by an individual or group for a common interest. Although there has been an explosion of PILs in our courts but as far as the enforcement of environmental legislation is concerned, PILs have played a boon for environmentalists. One point to be noted is that a PIL once filed, the petition cannot be withdrawn, i.e., the petitioner (the person filing the PIL) can withdraw himself from fighting further, but the PIL stands, and courts allow and invite public to fight the case if anybody is interested, although it takes time and fighting PILs requires a lot of patience also depending upon the case fought. But it is a very valuable legal remedy to fight for larger public interest.

(b) Filing cases under Tort Law (damages, injunctions, negligence, etc.)

(c) Taking legal aid under various Acts like :

(i) Public Liability Insurance Act, 1991

(ii) National Environmental Tribunal Act, 1995

(iii) National Environmental Appellate Authority, 1997

(iv) Environment Protection Act, Water/Air Acts, etc. as discussed in this lesson.

2.3.8 Environmental Ethics : Issues and Possible Solutions

Ethics is a subject in philosophy and it is related with moral philosophy i.e. what is morally right or wrong (unethical). With the deteriorating environmental conditions, people have started thinking about environmental ethics. Because in the natural environment, there are other living beings as well as human

persons. Like polluting the river water by human activities of industrial waste disposal is contaminating the water for animals, birds etc. also and it comes back to us for our own consumption in some way or other. If people have ethics while disposing the wastes then so much pollution had not arisen.

There are many ethical questions like, how much is it ethical to dispose chemical wastes in the flowing natural water bodies? Why some people litter anywhere in the open at public places but behave differently in their own homes while dis-regarding the planet home as a whole? Why just to show-off and panic others people use power horns? And why some drivers blow horns even at red signals? The list of questions can be infinite about un-ethical behaviour.

Environmental Ethics and Industry : The most damage to environment is done by industries and commercial organisations. And yet they try to defend themselves on developmental grounds and ignoring the environmental responsibility altogether. But overtime, this responsibility is gaining some grounds, like various countries have adopted environmental ethics in the code of ethics for their engineers.

Environmental Ethics and Individuals : A person's moral beliefs and values differ and affects his behaviour. But people can be taught also. But many times people follow the examples of others, whether ethical or not. Like when parents throw their wastes in the open at public places, very often children will follow them. Yet there are many environmental reformers whom we should follow like Sunder Lal Bahuguna, environmental lawyer M.C. Mehta etc.

Ethical Dilemma in Environmental Problems : It is easy to solve some problems but some problems pose ethical dilemmas also. Consider chlorination of water, chlorine is used to disinfect water, but research has evidence that chlorine forms carcinogens with many organics, so should it be used or should chlorination of water be stopped altogether?

	Do's		**Don'ts**
*	use CFL bulbs	*	smoke (atleast in public places)
*	reduce private driving	*	use horns unnecessarily
*	do cycling	*	listen music at full volume
*	plant more trees	*	litter in the open

* study your lessons thoroughly as many trees have been cut to print them on paper
* dispose chemicals in flowing water
* use fire crackers
* don't throw food items/wastes in plastic/polythene bags as cows eat these wastes and their excretion system gets choked/blocked by polythene bags.

2.3.9 Public Awareness

All the laws can be made available but unless general public is not aware, not much be done. Public awareness is needed to enforce environmental legislation and also for other environmental aspects especially relating to pollution.

Public awareness can be made by :

(1) **Newspapers :** They often contain awareness drives and initiatives by other people or government. Like many press released appear in newspapers on specific environmental days e.g. 31st May - No Tobacco Day.

(2) **Television and Radio** also give brief insertions on many environmental aspects viz. celebration of some environmental days; coverage on oceans, forests etc.

(3) **Internet :** Various sources of environmental information do exist on the internet. It can also be used to report online to government for various problems viz. making complaint where animals are being treated in-humanly.

(4) **Special Laws** like smoking has been banned in public places in many cities of India. Chandigarh is the first city to ban smoking at public places.

(5) **Celebrating various Environment Specific Days** like :

Earth Day	=	April 22
Car Free Day	=	September 22
No Tobacco Day	=	May 31, etc.

The masses of general public must be aware of various environmental legislations and other aspects especially relating to pollution because it is only the individual

who can take steps to save environment and an individual can lead by example and others will join to help to prevent and control the environmental pollution.

2.3.10 Conclusion

Various environmental legislations have been passed in India like the Water Act, Environment Protection Act, etc. to control and prevent various types of pollution in the environment. All these laws help in their own way to save our natural environment. Although there are various issues in the enforcement of these legislations but many benefits have been availed by many persons to help to protect the environment. Yet ethical behaviour is a need of the hour so that pollution should not arise or safety measures be taken to have pollution to the minimum. And public awareness can change many persons to help to protect the environment from pollution.

2.3.11 Self-Check Exercise

(1) Explain any 3 Acts :

- (a) Environment Protection Act
- (b) Water Act
- (c) Air Act
- (d) Forest Conservation Act
- (e) Wildlife Protection Act

(2) Discuss various environmental ethics.

(3) Discuss various issues involved in the enforcement of environmental legislations.

(4) Discuss public awareness in the light of environmental problems.

2.3.12 Suggested Reading & Web Sources

1. Text book of Environmental Studies : Dr. K. Raghavan Nambiar
2. Enviornmental Studies : R.R. Dass
3. Envrionmental Education : R. A. Sharma
4. Environmental Studies : R. Rajagopalam

Web Sources

1. www.globalissues.org
2. edugreen.teri.res.in
3. en.wikipedia.org.

2.3.13 Suggested Questions

1. Explain in detail the Environment Protection Act, 1985.
2. What do you mean by Environmental Ethics.
3. What are the issues involved in enforcement of environmental legislation?

Lesson No. 2.4 Author : Dr. Loveleen Chauhan

ROAD SAFETY AWARENESS

2.4.1 OBJECTIVES

After going through this lesson, students will be able to :

1. Understand the concept and importance of Road Safety.
2. Define Road Safety
3. Identify different traffic signs and rules
4. To know the various traffic offence and penalities
5. How to get the license
6. Role of first aid in road safety

2.4.2 INTRODUCTION

In Today's scenario if people practice road safety, driving safety and follow the rules, then they have a better chance of survival. Rules are in place to foster safety. Bicycle riders and Motorcycle riders that share the road with regular motorists need to practice extra caution due to the extra risk of exposure. Safty equipment such as helmets and protective clothing should be used it all times. Keeping passangers and children safe in your vehicle is the responsibility of the driver and using caution and common sense can prevent most problems. Use proper child seats, seat belts and airbag equipped vehicles whenever possible. Check the safety ratings of the items and vehicles that you buy. Keep dangerous goods labeled and safety out of the reach of children.

2.4.3 CONCEPT OF ROAD SAFETY

With the increasing population and vehicles on the road. It has become very difficult to walk on road. It is an issue which has affected so many people because there are so many deaths occurring due to accidents on roads. According to the news in Hindustan times India witnessed one road accident every minute in 2011 which claimed one life every 3.7 minutes, one of the highest in the world. So there is dire necessity that people should be made aware of the road safety in order to decrease such collisions in future. Younger generation is more prone to accidents and there is need to develop habits and skills in children to keep them as safe as possible. We as parents and elders need to give them the facts, show them dangers and risks, look at the consequences and build their understanding and skills to keep them safe always. These skills include setting good example of yourself like how you drive and treat others on road; talk with them about the importance of knowing the rules and regulations of road; show them various signs and signals when going outisde with them like zebra crossing etc.

2.4.3.1 MEANING AND IMPORTANCE OF ROAD SAFETY

The meaning of road safety according to Cambridge dictionary is "teach people how to behave safely when driving or crossing the road". Road traffic safety refers to methods and measures for reducing the risk of a person using the road network being killed or seriously injured. The users of a road include pedestrians, cyclists, motorists, their passengers, and passengers of on-road public transport,

mainly buses and truks. Vehicle speed within the human tolerances for serious injury and death is a key goal of modern road design because impact speed affects the severity of injury to both occupants and pedestrians. The old road safety paradigm of purely crash risk is a far more complex matter. Contributing factors to highway crashes may be related to the driver (such as driver error, illness or faitgue), the vehicle (brake, steering, or throttle failures) or the road itself (lack of sight distance, poor roadside clear zones, etc.). Interventions may seek to reduce or compensate for these factors, or reduce the severity of crashes. For road traffic safety purposes it can be helpful to classify roads into three stages :

1. Built-up urban streets with slower speeds, dense and diverse road users.
2. Non built-up rural roads with higher speeds;
3. Major highways reserved for motor-vehicles and designed to minimize crashes.

2.4.4 TRAFFIC SIGNS

Traffic signs are broadly classified into three main signs/signals :

2.4.4.1 Road Signals

2.4.4.2 Hand Signals

2.4.4.3 Hand Marking Signs

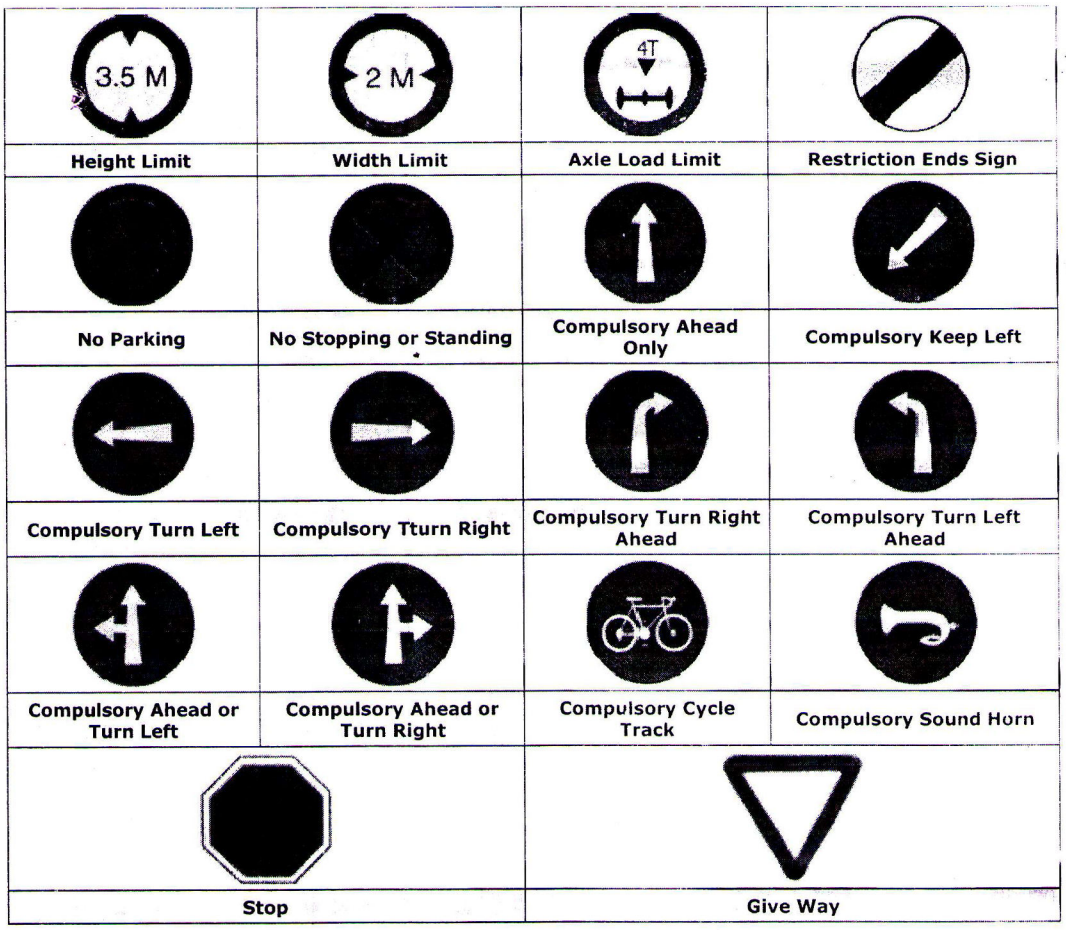
2.4.4.1 Road Signals are further divided into three types :

1. Mandatory Signs or Regulatory Signs
2. Cautionary or Warning or Precautionary Signs
3. Informatory Road Signs

1. Mandatory Signs or Regulatory Signs are round in shape and are in red and blue colour.

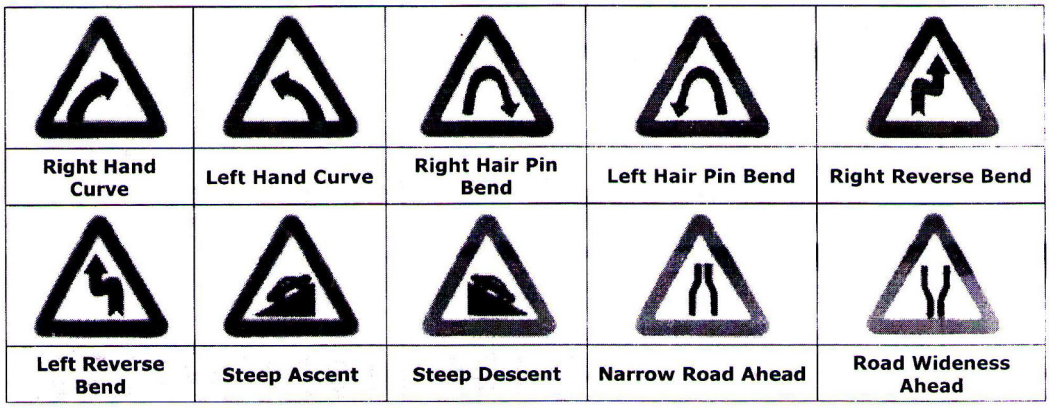
Picture Table-1

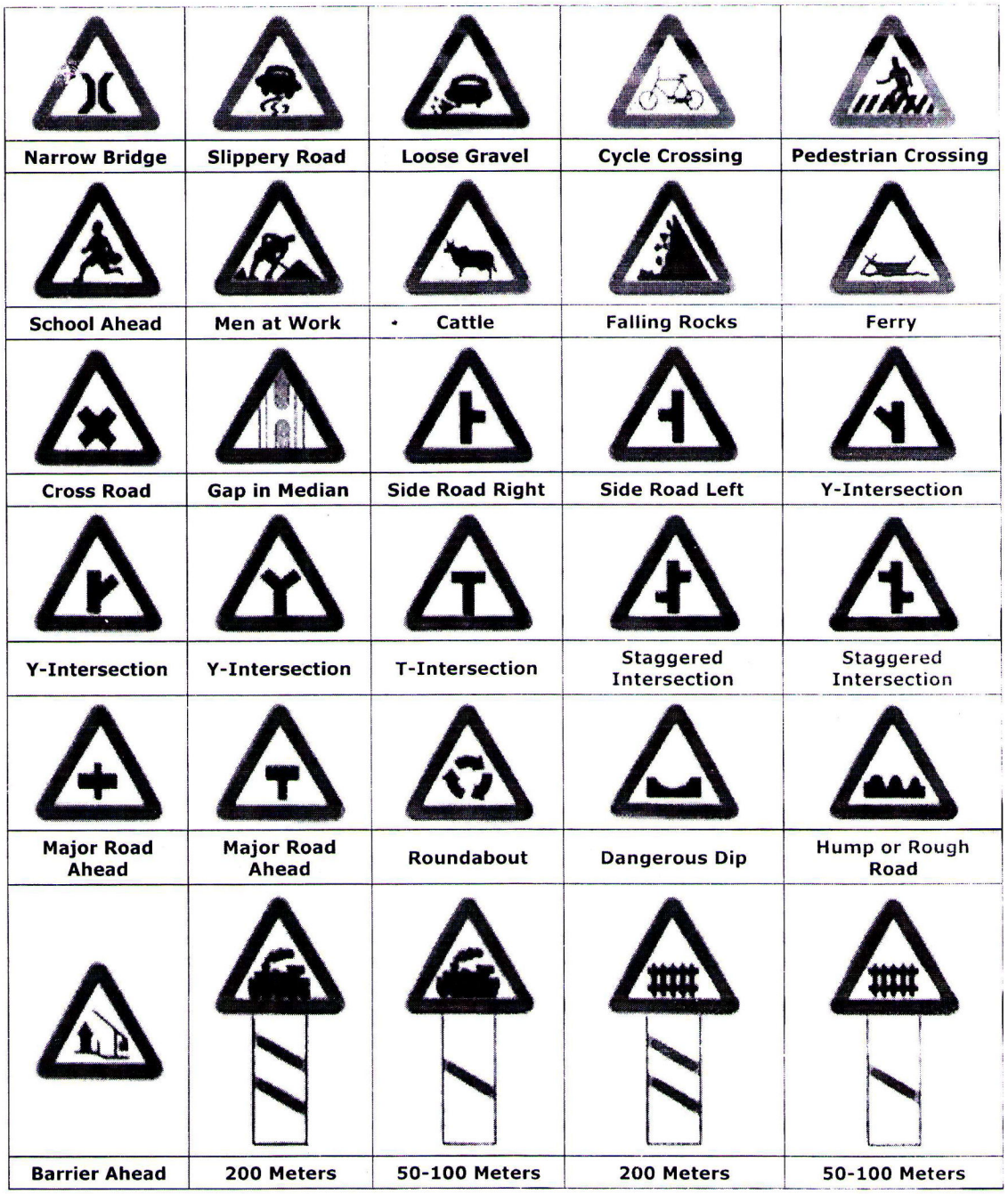
			
Straight Prohibited or No Entry	One Way Sign	One Way Sign	Vehicle Prohibited in Both Directions
			
All Motor Vehicles Prohibited	Truck Prohibited	Bullock Cart Prohibited	Tonga Prohibited
			
Hand Cart Prohibited	Cycle Prohibited	Pedestrians Prohibited	Right turn Prohibited
			
Left Tturn Prohibited	U-Turn Prohibited	Overtaking Prohibited	Horn Prohibited
			
Bullock Cart & Cart Prohibited	Length Limit	Speed Limit	Load Limit



2. Cautionary or Warning or Precautionary Signs are triangular in shape and yellow in colour are used for precautions or warning.

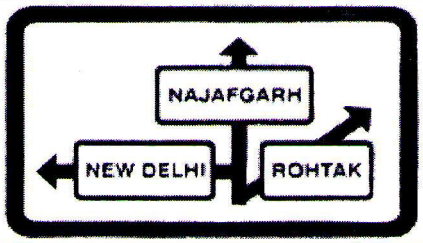
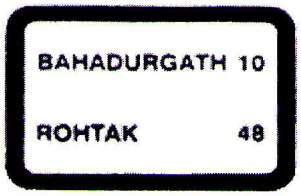
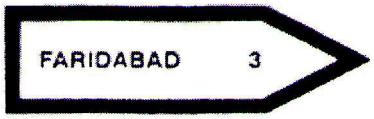
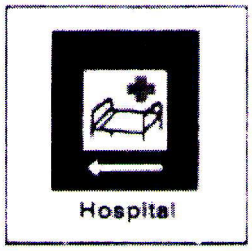
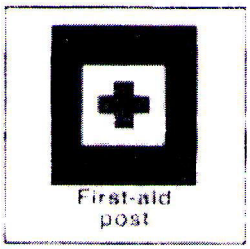
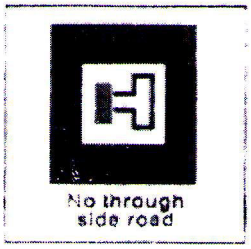
Picture Table-2



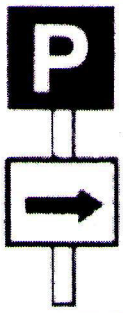
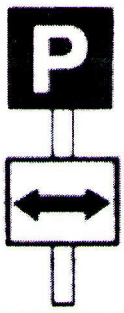
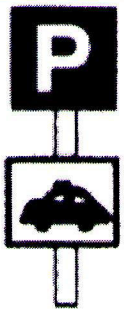
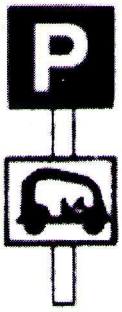
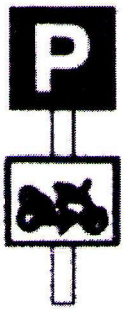
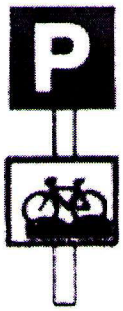
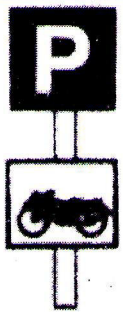
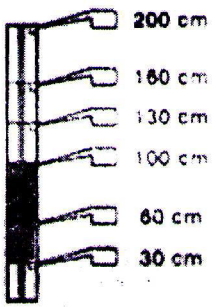

Narrow Bridge
Slippery Road
Loose Gravel
Cycle Crossing
Pedestrian Crossing
School Ahead
Men at Work
Cattle
Falling Rocks
Ferry
Cross Road
Gap in Median
Side Road Right
Side Road Left
Y-Intersection
Y-Intersection
Y-Intersection
T-Intersection
Staggered Intersection
Staggered Intersection
Major Road Ahead
Major Road Ahead
Roundabout
Dangerous Dip
Hump or Rough Road
Barrier Ahead
200 Meters
50-100 Meters
200 Meters
50-100 Meters

3. Informatory Road Signs with blue background depicts some information

Picture Table-3

	
Advanced Direction Sign	**Re-Assurance Sign**
	
Destination Sign	**Place Identification Sign**
	
Hospital	**First Aid Post**
	
Resting Place	**Eating Place**
	
No Through Road	**No Through Side Road**

Picture Table - 4

	
Park This Side	Park This Both Side
	
Parking Lot Taxis	Parking Lot Auto rickshaws
	
Parking Lot Cycle rickshaws	Parking Lot Cycles
	
Parking Lot Scooters and Motorcycle	Barrier Ahead

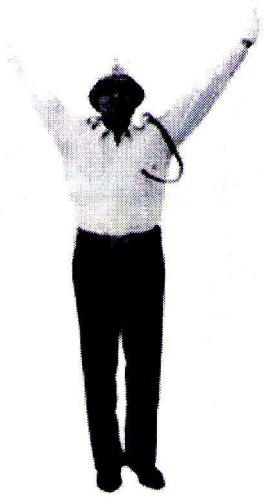
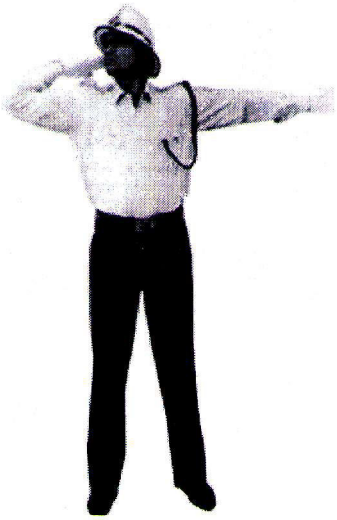
2.4.4.2 (II) Hand signals are of two types :

1. Hand signals by Traffic Police
2. Hand signals by drivers

1. Traffic Police Hand Signals

Picture Table-5

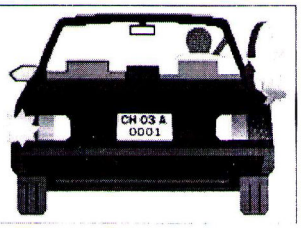
	
To start one sided vehicles	To stop vehicles coming from front
	
To stop vehicles approaching from behind	To stop vehicles approaching simultaneously from front and behind

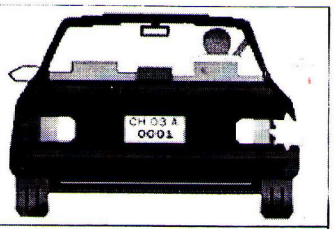
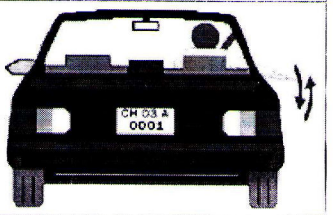
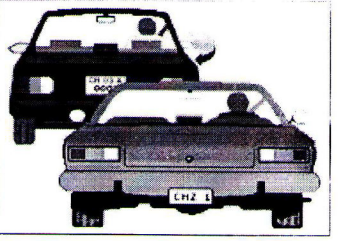
	
To stop vehicles approaching simultaneously from right and left	**To start vehicle approaching from left**
	
To start vehicles coming from right	**To change sign**

	
To start one sided vehicles	To start vehicles on T-Point
	
To give VIP salute	To manage vehicles on T-Point

2. Hand Signals by Drivers

Picture Table-6

I intend to move in to the left or turn left	

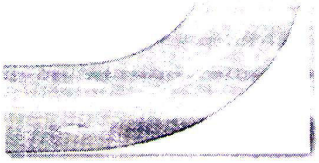
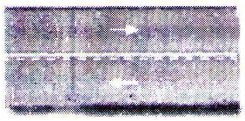
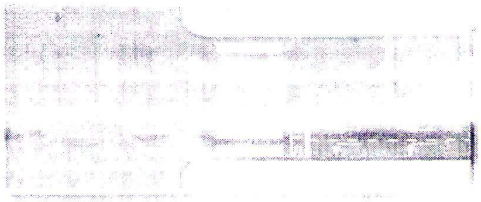
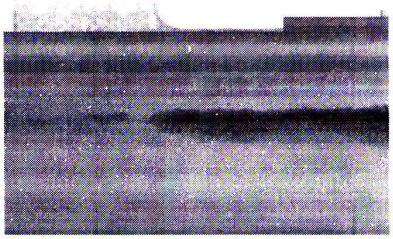
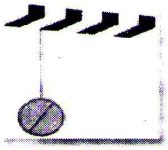
I intend to move out to the right or changing the lane or turn right	
I intend to stop	
I intend to slow down	
Indicating the car following you to overtake	

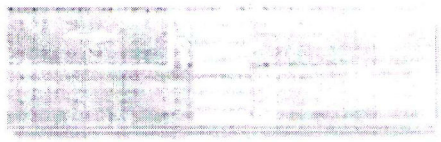
2.4.4.3 (III) Hand marking signs

Road marking or pavement signs

Picture Table-7

Centre Line Marking For A Two Lane Road	
Lane Line And Broken Centre Line	

Centre Barrier Line Marking For A Four Lane Road	
Centre Barrier Line Marking For A Six Lane Road	
Double White/Yellow Lines: Used where visibility is restricted in both directions. Neither stream of traffic is allowed to cross the lines.	
Combination Of Solid And Broken Lines: • If the line on your side is broken, you may cross or straddle it. OverTake - but only if it is safe to do so. • If the line on your side is continious you must not cross or straddle it.	
StopLine: A stop line is a single solid transverse line painted before the intersecting edge of the road junction/ intersection. This line indicates where you are required to stop when directed by traffic officer, traffic light of stop sign. Where a pedestrian crossing is provided, the stop line is marked before the pedestrian crossing.	
GiveWayLine: The give way line is usually a double dotted line marked transversely at junctions. These lines are generally supplemented by a reverse triangle give way sign painted on the road surface before the dotted lines or by a road sign installed besides the marking. Give way to traffic on the main approaching road.	
BorderorEdgeLines: These are continuous lines at the edge of the carriageway and mark the limits of the main carriageway upto which a driver can safely venture.	
ParkingProhibitedLines: A solid continuous yellow line painted on the kerb or edge of the carriageway along with a "No-parking" sign indicates the extent of no-parking area.	

Yellow Box Junctions or KeepClear: These are yellow crossed diagonal lines within the box. The vehicles should cross it only if they have a clear space available ahead of the yellow box. In this marked area vehicles must not stop even briefly.	
PedestrianCrossings These are alternate black and white stripes painted parallel to the road generally known as zebra crossing. Pedestrians must cross only at the point where these lines are provided and when the signal is in their favour at controlled crossings. You must stop and give way to pedestrians at these crossings. Pedestrian crossings are marked to facilitate and give the right of way to pedestrians.	

Courtesy: www.indiandrivingschools.com

2.4.5 TRAFFIC RULES AND REGULATIONS

* **KEEP LEFT** to allow the traffic to pass on a two-lane road coming from an opposite direction on the right side and allow the vehicles on one-lane road behind you for overtaking from the right.
* **WHEN TURNING LEFT,** be on the road's left side from where you leave as well as from where you enter. When turning towards right, move towards the road centre when you leave and when you enter, arrive near road's left side.
* **SLOW DOWN** your speed at pedestrian crossings, road corners, intersections and road junctions and wait there till the passage ahead gets cleared. If you enter the main road then give way of passage to the vehicles passing by on the right side as the traffic on the main roads is not regulated.
* **HAND SIGNALS** becomes necessary to give at times. Extend and pull out your right hand's palm down when slowing the vehicles and swing the hand in the down and up direction. While stopping, your forearm should be raised outside vertically the vehicle, while changing the road lane or turning right towards left side, extend and rotate the right arm in a direction of anti-clockwise. To let the vehicle overtake behind you, swing the right arm forwards and backward in a motion of semi-circular.
* **DIRECTION INDICATORS** instead of giving hand signals make use of direction indications and in case of emergency, use both.

* **WEARING A HELMET FOR TWO WHEELER DRIVERS** is compulsory. The helmet should bear and conform to ISI mark and ISI standards. It works like a shield or a cover for the head during any mishap that occurs. It is so designed that it provides individual safety. It is not for covering any legal prosecution. Tie the helmet strap properly for the safety otherwise the strap of the helmet may get slipped from the head during any head injury in an accident. (Sikhs wearing Turbans are exempted from wearing a helmet).
* **DO NOT PARK** near or at any road crossing, on a walking footpath or on the hill top, near pedestrian crossing or traffic light, road having heavy traffic or on main road, opposite or in the front of another vehicle parked to cause any obstruction, on white line roads, near hospital entrance, school or bus stop, next to the traffic signal whereby blocking the path for others, near any fire hydrant whereby the access gets blocked, at any buildings entrance, where it is restricted to park.
* **THE REGISTRATION MARK** on the vehicles should be very legible, visible and clear all the times. Motor vehicles should not be loaded creating any obstruction for the marks, or the tail or other lights which are required for the vehicles safety.
* **DO NOT DRIVE** on one-lane road except driving in the permitted directions. Reversing the vehicle in a wrong direction in a one-lane street is prohibited.
* **DO NOT CROSS THE YELLOW LINE** even while you are overtaking, that divides the road. On roads having defined lanes, appropriate signal indicators should be used before changing the lanes.
* **DO NOT CROSS THE STOP LINE** that is painted when you are stopping at any road intersection or junction or any pedestrian crossing. Beyond the marked line, your vehicle shall not bot move in any case.
* **TOWING IS PERMITTED** for only the vehicles which are disable mechanically or motor vehicles incompletely assembled, side cars and registered trailers. Other than this, vehicles can be towed to any nearest garage for delivery or at petrol pumps when they are untimely damaged.
* **USE THE HORN** when it is essential only and not in any silence zone area. Do not use or fit any multi-toned, loud or shrill and harsh sounding alarms or horns in the vehicles that causes disturbance. It is also prohibited to have vehicles having altered silencers on road.

* **DIRECTIONS GIVEN TO DRIVERS** which are either through the regulating traffic police officers or through traffic signals or road signals should always be followed. It is an offense if such directions are violated.
* **MAINTAIN ADEQUATE DISTANCE** from any vehicle driving ahead of your vehicle in order to avoid any collusion taking place in case if the vehicle stops of slows down suddenly, it might cause accidents. On page number 33, a chart is given for any further information to guide on the required time for applying minimum brakes at various speeds.
* **DO NOT BRAKE SUDDENLY** other than any safety reason is there.
* **ON MOUNTAINS AND STEEP ROADS**, any vehicle that is driving uphill on a road must be provided the correct way by the vehicles that are coming downhill. The road in case not wide sufficiently to give way then stop your vehicle on any road side and let the driver who is going uphill on the road to first proceed.
* **WHEN ROAD REPAOR WORK** is in progress, slow down the speed of the vehicle and drive at a maximum of 25 km/hours speed.
* **DRIVERS OF TRACTORS AND GOODS VEHICLES** are not allowed to carry passengers for reward or hire. The driver in tractors should not have any person and he should not have more other required person permitted to have in the cabin of the drive in a vehicle of goods.
* **DO NOT CARRY GOODS** on any vehicle in such a way that it causes any danger to any person, or even load it in a way that the material or the goods on the vehicle laterally extends to the front, rear side or beyond any sides of the motor vehicle. Carrying dangerous, inflammable or explosive substances are prohibited taking by any vehicle of public service.
* **CARRY ONLY ONE PILLON RIDER** on a two wheeler. A rider can sit only on vehicles back seat. A rider should not be allowed to stand or sit (even a children) in the front seat. It is illegal and dangerous as well as when applying sudden brakes, the person sitting in front gets thrown out hitting the front vehicle. It is law's violation to carry any goods on a two wheeler due to imbalance caused to the rider that leads to accidents.
* **DO NOT DRIVE BACKWARDS** much longer than it is necessary and ensure that no inconvenience or danger is caused to any vehicle or any

person while driving backwards.

* **DO NOT DRIVE** if you have any sickness or not well or taking any medications that impairs your abilities of driving including tonics containing some alcohol content.
* **WHILE OVERTAKING,** overtake from the right direction of the motor vehicle being passing by. If there is an indication from the front vehicle driver indicating his turning towards right then you should pass from the left side. Remember to not overtake heavy vehicles or cut their way as they need much space to stop or slow down.

2.4.6 TRAFFIC OFFENCES AND PENALTIES

Everyone should know the traffic rules and regulations to help to keep the road safe for drivers and pedestrians. Ignoring these laws and rules can result in expensive traffic fines or, for serious offences, removal of your license. Dangerous or negligent driving that result in someone being injured or killed can lead to a criminal conviction and prison.

People using roads in any way can be exposed to serious safety hazards when they encounter :

* pedestrians incrosswalks or using walk lights at schools, malls and in residential areas;
* youth who are learning to drive or even;
* experienced drivers who may be distracted, or
* Elderly and siabled people.

There are offences mainly categorized into offences related to :

* Documents
* Towing of vehicles
* Driving
* Pollution
* Parking

1. **Offences related to Documents :** Driving without license, insurance, permit fitness; who do not have valid licnese; not carrying documents and driving without valid registration copy get a penalty

ranging from Rs. 100 up to Rs. 10,000 or imprisonment of three months to one year depending upon the type and seriousness of the offence.

2. **Offences related to towing of vehicles :** Towing of two wheeler, Car, Jeep, Taxi, Auto Rickshaw, truck and tanker get penalty of maximum Rs. 600.

3. **Offences related to Driving :** Driving by minor; unauthorized person; without helmet; without fastening seat belts; rough/rash/ negligent/hasty driving and driving on wrong side; disobeying traffic signals are fined up to Rs. 1000 or imprisonment up to six months.

4. **Offence related to pollution :** Smoking in public transport; pollution not under control: blowing pressure horn or noise of any kind can be fined up to Rs. 10,000.

5. **Offences related to Parking :** Wrong parking causing obstruction in traffic, parking in "NO" Parking Zone can be fined up to Rs. 500.

2.4.7 HOW TO OBTAIN LICENSE

A Driving License is an official document certifying that the holder is suitably qualified to drive a motor vehicle or vehicles.

Indian Driving License

In India, two kinds of Driving Licenses are issued : Learner's License and Permanent License.

1. Learner's License is valid only for six months.
2. Permanent License can be availed only after the expiry of one month from the date of issuance of the Learner's License.

A Learner's License is essential for obtaining a Permanent Licnese. The eligibility for obtaining a Lerner's License for a private motor vehicle for a vehicle of 50 CC engine capacity and without any gear, is 16 year (if the applicant's parents or guardians give their consent). The minimum age to apply for a permanent license to drive a private motor vehicle is 18 years.

A person who is at least 20 years old and possesses a Learner's License can obtain a License for driving a commerical vehicle. Also, one has to conversant with the traffic rules and regulations in all the cases.

For obtaining a Learner's License one need to apply in the prescribed format to the Local Transport Office of your region, along with

1. Your passport-sized photographs,
2. Proof of your age and residence,
3. Declaration of medical fitness and
4. The required fee.

After verification of your documents, you will have to go through the Learner's Test. Usually a handbook of traffic rules, signs and regulations is provided with the application form. On passing the Learner's Test, you will be issued a Learner's License. If you fail the test, you will be given a chance to take the test again.

For obtaining a Permanent License, you must have a valid Learner's License, and must apply after 30 days and within 180 days of issue of the Learner's License. You should be conversant about vehicle systems, driving, traffic rules regulations. You will be put through a driving test, for which you must bring a vehicle with you. On passing the test, you will be issued a permanent Driving License.

2.4.8 ROLE OF FIRST AID IN ROAD SAFETY

Large number of people die in road accidents not only due to lack of proper roads, rash and negligent driving but due to the fact that they are not given proper mediciation and first and on time. It is every individual's responsibility that if we find someone injured due to accident on road then we should immediately help that person and do not ignore because this situation can be faced by anyone on the road.

First-Aid is an immediate and temporary medical care of any victim prone to an accident with the aim of preventing or reducing an acute threat to his life. It is provided by a person who may not be a physician but a trained first aider. The basic aims of first aid are :

* To save life
* To protect the casualty from getting more harm
* To reduce pain and Priorities of Casualty Treatment

We should always keep in mind the following thing while giving first aid to the injured :

1. **Check yourself first :** If you have been injured in the accident, first check yourself for any injuries. Try to assess how well you can move your limbs, and if you experience syptoms such as dizziness etc. Remember you need to be fit enough to help the others.

2. **Check the other person(s) for injuries :** If other people are injured, first assess the extent of his/her injuries. For e.g. is he bleeding from the head, neck, arms legs, abdomen back etc. Treat that person first, as they are usually more seriously injured or cannot breathe. Use a clean cloth as a compress to stop the flow of blood from a serious wound. In the case of head wounds, however, experts suggest you use as light a pressure as possible because he could have a fractured skull. People who can talk or scream, on the other hand, can breathe therefore can be treated a little later. Ask for the patient's name, if he responds, it means he is able to understand the situation and has most likely not suffered a severe head injury.

3. **Look for signs of breathing :** Next, check if the person is breathing and if he has a pulse.

4. **Call for help :** Immediately call for an ambulance or rush the person to a hospital. Once you know more about the patient's condition you will in a better position to tell the doctors about his/her condition.

5. **Check for obstructions in the person's mouth and throat:** If you do not hear any breath sounds, check his/her mouth for any obstructions. If there is something obstructing the airway, use your index and middle finger to clear the airway.

6. **Perform life saving techniques :** If there is no pulse, start CPR or EAR. Keep the person's neck straight to start EAR (External Air Resuscitation i.e. to restore consciousness through artificial respiration) There are 3 types of EAR; Mouth-to-mouth, Mouth-to-Nose, Mouth-to-Mask or CPR (Cardio pulmonary resucitation). CPR can only be done if person is trained in that.

7. **Ways to help him/her in grave situations :** If there is bleeding from the mouth or the patient is vomiting, turn the person to his/her side. This will avoid any chances of the person choking. Place the person's arm that is under him straight out and the arm closest to you across his chest.

8. **Deal with open wounds :** If there are extensive wounds, try to control the bleeding using pressure to the area using a cloth. Press down with your palms rather than your finger tips.

9. **Always suspect spinal injuries :** If the person's neck is in an awkward position (not normally placed) or the person is unconscious, do not move the patient. Get help immediately. This could mean that the person's neck is broken, and moving him/her in such a situation can cause more harm than good.

10. **Keep the person warm :** Usually accident victims feel excessively cold due to shock. Therefore keeping them warm is essential to survival and prevent them from shock.

11. **Avoid feeding the person :** Do not give the person any water, food or other fluids through the mouth; it could lead to the choking.

2.4.9 SUMMARY

Problems and accidents can be out of your control but you can do your best to equip yourself with the knowledge and tools to act fast in a situation that requires quick thinking. Safety preparedness can save a life. Thus while concluding we can say that one should drive their vehicles with all documents like valid driving license, registration copy, insurance, pollution certificate to avoid fines and punishments as per Indian Motor Vehicle Act 1988 and using safety measures like controlled speed, safety belt,s helmets and taking first and kits and at the same time follow all traffic rules and regulations for your safety as well as of your family and public and be a good citizes of India.

2.4.10 Suggested Reading and Web Source

Environmental Studies - By Meenakshi Verma

Web Sources :

1. www.nationwideeducation.com
2. www.road.safety.co.za
3. www.safeide.org
3. www.indiandrivingschools.com
5. en.wikipedia.org
6. www.traffisigns.co.in

2.4.11 Suggested Questions

Q.1. Explain the concept of road safety. Why it is important ?

Q.2. Write down the procedure of obtaining license for a beginner.

Q.3. Discuss the role of first aid in road safety.

Q.4. Elaborate the general rules of traffic.

Q.5. Give different categories of road traffic signs and explain them.

Q.6. Explain about the various traffic offences and its penalities.

Environmental Movements; Environmental Communication; Resettlement and Rehabilitation of Project Affected Persons

Structure

2.5.1 OBJECTIVES

After going through this lesson students will be -

1. Aware of various environmental movements.
2. Describe and discuss various environmental movements.
3. Understand and explain environmental communication.
4. Understand the problems of project affected persons.
5. Understand and explain various strategies for resettlement and rehabilitation of project affected persons.

2.5.2 INTRODUCTION

Social movements represent a method of social change. Movement is aimed at bringing about a change in values, norms, ideologies of the existing system. Role of movement is to allow people the opportunity to come together, speak their mind & make them aware of an issue that is close to their heart. Environmental movements and Environmental communication are the best ways to make people aware about the issues and problems of environment. From the ecological point

of view a cautious behaviour leading to minimization of ecological disruption would be necessary requisite for sustainable development. In this chapter we will discuss environmental movements, environmental communication and rehabilitation of project affected persons.

2.5.3 ENVIRONMENTAL MOVEMENTS

The green politics or green movement or environmental movement can be defined as a social movement for the conservation of the environment or for the improvement of the state policy especially inclined towards the environment. In other words, it is the movement to protect the environment through changes in public policy. Here, brief history of the Environmental Movements in India have been given that will enhance the knowledge of the students about how the mass movement can save the atrocities against the environment.

2.5.3.1 SILENT VALLEY MOVEMENT

A social movement called as Save Silent Valley was started with the aim of protection of Silent Valley which is a moist evergreen tropical forest in the Palakkad district of Kerala from being destroyed by a hydroelectric project. It was started in 1973 to save the Silent Valley Reserve Forest. The valley was declared as Silent Valley National Park in 1984. Actually the least population of world's rarest and most threatened lion-tailed macaque is found in Silent Valley.

A hydroelectric dam across the Kunthipuzha River that runs through Silent Valley was proposed by the Kerala State Electricity Board (KSEB). The project gets approval in February 1973 from the Planning Commission. This created terror in the people and they get feared that the project would submerge 8.3 sq km of untouched evergreen forest. Then several NGOs came forward and strongly opposed the project and demanded that the government should abandon it.

After the announcement of construction of hydroelectric dam the valley became the focal point and simultaneously the movement to Save Silent Valley was started because of concern about the endangered lion-tailed macaque. In 1977 the Kerala Forest Research Institute carried out an ecological impact study of the Silent Valley area and proposed that the area be declared a biosphere reserve. Various social activista played important role in save Silent Valley movement. The poet as well as activist Sugatha Kumari played an important role in the Silent Valley protest and her poem "Marathinu Stuthi" ("Ode to a Tree:) became a symbol for the protest from the intellectual community and was the opening song/prayer of most of the "save the Silent Valley" campaign meetings. Dr. Salim Ali, eminent ornithologist of the Bombay Natural History Society, visited the valley and appealed for cancellation of the hydroelectric project. A petition of writ

was filed before the High Court of Kerala, against the clear cutting of forests in the hydroelectric project area and the court ordered a stop to the clear cutting.

In 1978 the then Prime Minister of India, Mrs. Indira Gandhi, approved the project and advised the state government regarding enactment of legislation ensuring the necessary safeguards. IUCN (International Union of conservation of nature) passed a resolution that year recommending protection of lion-tailed macaques in Silent Valley. The controversy heated up. In 1979 the Government of Kerala passed legislation regarding the Silent Valley Protection Area (Protection of Ecological balance Act of 1979) and issued a notification declaring the exclusion of the hydroelectric project area from the proposed national park. In January 1981 the government bow to the public pressure and Indira Gandhi declared that Silent Valley will be protected. As a result the Silent Valley Hydroelectric Project was called off in November 1983. The Silent Valley National Park was formally inaugurated by Prime Minister Rajiv Gandhi in 1985. On 1 September 1986 Silent Valley National Park was designated as the core area of the Nilgiri Biosphere Reserve. Since then, a long-term conservation effort has been undertaken to preserve the Silent Valley ecosystem.

The present situation is that on June 6, 2007, the 147.22 km^2 Silent Valley Buffer Zone was formally approved by the Kerala Cabinet and a staff of 35 was also sanctioned to protect the area and two new forest stations in Bhavani range at Anavai and Thudukki. Checking the illicit cultivation of ganja, poaching and illicit brewing in areas adjacent to Silent Valley and help long-term sustainability of the protected area is the main aim of the project.

Key Role:

The Kerala Sastra Sahitya Parishad (KSSP) an NGO, and the poet-activist Sughathakumari played an important role in the Silent Valley protests.

2.5.3.2 BISHNOI MOVEMENT

In the heart of the barren western Thar Desert and northern states of India lives a religious section of Bishnois. It was founded by Guru Maharaj Jambaji in 1485 AD in the Marwar (Jodhpur) desert region of Rajasthan. It is a community of nature worshippers who with their compassion and faith have created a sanctuary like destination where beasts, birds, and humans live in awe-inspiring harmony. The devotion of the Bishnois' community is matchless when it comes to preservation of flora and fauna. Bishnois have shown their dedication many times. They follow the conservative teachings of their progenitor/ forefather, which are quite simple and contemporarily ecologists. It is a non-violent community. It has been found that 29 tenets are there which govern the lifestyle of this religious section of the society. These principles are "all boil down to the

condemnation of the universal sins like lying, lust, anger, greed, and intoxication, with one noteworthy amendment of compassion towards all living beings, including animals, and even green trees". They take care of trees and even shrubs with their kindred spirit.

The compassion Bishnoi's is outstanding, considering that despite living in the rural areas of a state that is predominated by barren desert, they do not consume meat. In fact, they try to build shelters for male cattle to save them from being slaughtered by other people. Even in the lack of fuel resources, they do not cut green trees, even humbly, and survive only on the dried broken branches of dead trees and dried cow dung cakes. Such generous teachings of the tranquil people of Bishnoi section of the society has created a harmonious habitat in the middle of the Thar Desert.

Beginning of Bishnoi Movement

Several incidences witnessed that many Bishnois have sacrificed their lives for the sake of saving animals and trees. Even, the first ever recorded environmental revolution related to trees i.e. the Chipko movement of 1973, was inspired by a similar but less fortunate act of Bishnois conducted back in the early 18th century.

Amrita Devi, a Bishnoi woman initiated the movement when Maharaja of Jodhpur ordered his officials to went to her native village Khejarli, to cut down the green Khejarli trees for the collection of timber. Then Amrita Devi, along with 84 villagers hugged the trees to their bosom to protect them from hacking and being cutting down. Unluckily, this protest of villagers was thought as a bluff/fraud and the officials in their haste cut many villagers who were embracing the trees. This bloodshed once started, continued till the then King rushed himself to the village to stop that action and apologized and declared the region as protected area. This movement took the lives of 363 Bishnois who died to protect their sacred trees as well as faith. However, that movement brought Bishnois in the consideration of administration which then passed a royal announcement that restricted hunting and wood-cutting activities in the areas populated with Bishnoi community.

Even then illegal minds can't be stopped by any rule. Since then many incidents of unlawful hunting and tree felling occurred. Bishnois are on their toes to prevent such acts from happening and are very cautious. Such prohibited activities took life of many Bishnois. "Willing to sacrifice" is a short film that portrays in brief the life of the Bishnoi community. The film was awarded for the Best Environment Film at the 5th International Festival of Films, TV and Video Programmes.

2.5.3.3 CHIPKO MOVEMENT

Eco-development needs public support for the conservation of trees. One of the very good example of public support is the chipko movement of Bishnoi women in U.P. the movement was started in a very small hilly village of upper reaches of Himalaya. In 1972 this unique movement commenced in the Chamoli district and later at Tehri-Garhwal district of Uttarakhand. The movement actually gains momentum in 1978 when women faced police firings and other tortures. The movement had broad-based objectives as it questioned the pitiless massacre of nature to achieve the short term gains which ultimately led to the ecological degradation and various crises to humanity. The women of Advani village of Tehri-Garhwal tied the sacred thread around trunks of trees and they hugged the trees and faced police firingin February 1978 and later courted arrest, hence this movement was called 'Chipko Movement' or 'hug the tree movement'. Sundarlal Bahuguna, Gaura Devi, Sudesha Devi, Bachni Devi, Chandi Prasad Bhatt, Govind Singh Rawat, Dhoom Singh Negi, Shamsher Singh Bisht and Ghanasyam Raturi were the main leaders of this movement. The main objective of this movement was to protect the trees on the Himalayan slopes from the axes of contractors of the forest.

Mr. Bahuguna enlightened the villagers by conveying the importance of trees in the environment which checks the erosion of soil, cause rains and provides pure air and protect the earth and environment from landslides and avalanches and global warming. The Chipko plan was infact a slogan of planting trees with a purpose of five Fs i.e. food, fodder, fuel, fiber and fertilizer to make the communities self-sufficient in their basic needs. The then state Chief Minister, Hemwati Nandan Bahuguna set up a committee to look into the matter, which eventually ruled in favor of the villagers. This became a turning point in the history of eco-development struggles in the region and around the world.

Mr. S.L. Bahuguna along with a team of dedicated workers later undertook marches of 300 km from Sringar to Siliguri. People from many countries visited Mr. Bahuguna to have accounts and experiences of his marchrs in different parts of the country. To mark the world Environment Day on 5th June in an exhibition organized by Stockholm following was wrriten about Chipko Movement.:

"A powerful environmental movement has grown up on the slopes of mountains of Himalayas. Villagers have created an effective non-violent way to stop the devastation by forest industries. When the axemen comes, the people form ring (circle) around the trees – they embrace the trees. This has given the name **Chipko Andolan** the tree hugging environment".

2.5.4 Environmental Communication

Environmental communication can be described as communication about environmental affairs. This comprised of all the diverse forms of interpersonal, group, public, organizational, and mediated communication that make up the social debate about environmental issues and problems, and our relationship to the rest of nature. It can be a lay activity as well as a field of professional practice. For example - Anyone who is participating in these discussions is engaging in the activity of environmental communication. That includes everyone from the most passionate environmental advocates, to the fiercest opponents of ecological protections. In this sense, it is both a lay activity that anyone can undertake, and a field of practice that professional communicators have created.

2.5.4.1 Environmental Communication - As an interdisciplinary field of study

Environmental communication is an interdisciplinary field of study that examines the role, techniques, and influence of communication in environmental affairs. Basically, it studies the activity and in doing so, it draws its theory and methods primarily from communication, environmental studies, psychology, sociology, and political science. Who, what, where, when how and why are some of the interconnected dimensions of the communication.

What are the facets of the environmental issues that are being discussed? What are the reasons of emphasizing? What will be its implications? Science, costs, risks, problem definitions, possible responses, values, agency, responsibilities, future visions, and ideas about nature are the key patterns of discussions and are known as discourses.

Where and when does the communication should take place? How are people communicating? How should people be communicating? Central goal of environmental communication is to discern and promote good practices. Environmental communication is a practical, and indeed essential, tool for action. It serves two broad social functions. The first is that we use communication to do things. For example, we communicate in order to inform, persuade, educate, and alert others. Similarly, we use communication to organize, argue, reconcile, and negotiate with each other, among other things. In this way, environmental communication is a practical, and indeed essential, tool for action. As such, it deserves careful scrutiny. Communication shapes how we see and value the world. To some extent it is related to our perception. The second broad social function of communication is that it helps to create a meaning. Communication shapes how we see and value the world of things,

events, conditions, ideas and so forth. In environmental affairs, communication guides our understanding of the issues, the problems that underlie them, the people and organizations involved, the possible approaches that can be taken, potential futures, and most importantly, the natural world itself. Another area of concern of EC is how well we communicate with each other about nature and environmental affairs which ultimately influence how well we address the ecological crisis.

Better policies, cleaner energy sources, new technologies, carbon taxes and all of the other innovative approaches to deals with environmental issues will help us to address our environmental problems. In order to achieve lasting ecological sustainability, human culture (especially in wasteful Western societies) is going to have to change as well. There is need to have some significant shifts in our views and values towards the natural world, ourselves, and towards each other. So, how well we communicate about nature and environmental affairs will affect how quickly and thoroughly we can transform our cultures and ultimately how well we address the ecological crisis.

2.5.5 Resettlement and Rehabilitation

People are forced to move out of their land due to both natural and manmade disasters. Natural disasters like earthquakes, cyclones, tsunami etc. render thousands of people homeless and sometime even force them to move and resettle in other areas. Similarly, developmental projects like construction of roads, dams, canals and flyovers displace people from their homes. Leakage of nuclear material in Japan resulted in millions of people being forced to leave the area for their safety. Thus, resettlement refers to the process of settling again in a new area. Rehabilitation is a program that helps a person who is recovering from illness or injury to regain as much function as possible. Thus, it means restoration to the former state.

2.5.5.1 Resettlement and Rehabilitation of Project Affected Persons

People inhabiting particular localities often get destabilized and are forced to leave the place to settle at some other place. The process of resettlement and rehabilitation involve proper arrangement not only for their habitation but also for their vocation as well as employment. There are several causes for migration of people. The factors can, however, be classified into two categories i.e. natural and anthropogenic. Each of the categories has a set of causes as follows:

a. Natural: earthquake, flood and storm
b. Anthropogenic: developmental and destructive

In this chapter we will discuss about the resettlement/rehabilitation for such project affected persons:

Construction of Dams: Dam is single such human activity which is responsible for displacement of maximum number of persons from their natural abode and inflicts maximum damage to the area. It causes large scale destruction of habitat through submergence and annihilation of existing terrestrial ecosystem. The civilizations occupying the banks of the river being dammed submerges the total heritage of the existing culture. The worst hit these operations are the tribal who lived in harmony with the nature and hence they are the worst hit by these atrocities and have to bear the bitter memories of being displaced from their hand.

The key issue in the erection of a dam is to estimate the number of persons being displaced from their homes together with the cost forest loss in terms of the loss of genetic diversity. It is expected that government shall take adequate measures to rehabilitate the displaced population. It would not be out of place to examine the instruments available in the hands of government to meet these experiences. The government is armed with Land-Acquisition Act, 1894 through which it can acquire land for the resettlement of displaced persons and also take their land to submerge after erection of the dam. Government machinery is ill-equipped to provide 'just rehabilitation package' to the displaced people who are on lower economic ladder.

The objective of 'just rehabilitation package' for displaced persons from the dam site:

- The displaced people should get appropriate share in the fruits of development.
- Rehabilitate them by creating new settlements within the environment akin to their own.
- Removal of poverty of the displaced persons and hence each displaced persons be provided with some land along with the assurance for their employment.
- Predominantly rural and forest lands are utilized for development of industries and people of these areas are rendered jobless and hence migrate from there and constitute the slums of urban and industrial area. A proper rehabilitation policy would have reduced slums of cities to a consideration extent.

During the last quarter of century, Government of India had faced strong anti-dam movement. They raised a worldwide debate on question-Development at what cost? Governments' responses towards these movements have been quite varied. People agitated the matter before Honourable Supreme Court and it had intervened in a number of instances. The protest of environmentally-conscious

mass associated with rich forest e.g., Silent Valley, Bodhghat and Bedthi, but the protest has been of no avail in cases the key issue was of proper rehabilitation of displaced persons. In India about 14-22 million people have been displaced by erection of dams. Anti-dam struggle has sparked for following:

1. Bargi
2. Bedthi
3. Bhopalpatnam
4. Bilaspur
5. Bodhghat
6. Koelkaro
7. Maheshwar
8. Mansi-Wakal
9. SardarSazrovar Project
10. Subarnarekha
11. Tehari
12. Vishnuprayag

Soon after the independence the new dams erected were considered as the monuments of progress, but the present protest against the big dams raise two issues: rehabilitation and environmental friendly project. Enakshi Ganguly Thukaral of Indian Population Council says. "there was a time when dams were the panacea for all the ailments of the country. Now they have started questioning whether it is the solution in the first place." Ramaswam Iyer of the Centre for Policy Research while reviewing Sardar Sarovar and Tehari projects has remarked that "while everyone pays lip service to environmental and social concern, very few are willing to undertake a radical re-examination of an on-going project. It is readily assumed that such projects are beneficial and necessary and without such projects there can be no development."

Construction work should not be initiated unless an adequate and proper arrangement for would be displaced persons has been made. Government must prepare a national level appropriate resettlement policy so that same is free from any ambiguity.

2.5.7 SUMMARY

In this chapter we have studied about various environmental movements, for example-Silent Valley Movement, Bishnois of Rajasthan and Chipko Movement. All these movements were focused on the conservation of environment or for the improvement of the state policy towards the environment. Knowledge about environmental Movements in India enhance the awareness of the students about

how the mass movement in which efforts have been made to save the violence against the environment.

Environmental communication can be described as communication about environmental affairs. This comprised of all the diverse forms of interpersonal, group, public, organizational, and mediated communication that make up the social debate about environmental issues and problems, and our relationship to the rest of nature. It can be a lay activity as well as a field of professional practice. Project affected and displaced people should get appropriate share in the fruits of development. Provisions should be made by the government to rehabilitate them by creating new settlements within the environment akin to their own.

2.5.8 SUGGESTED QUESTIONS

Q.1 Explain the term environmental movements. Discuss any one environmental movements in detail.

Q.2 Define environmental communication? How does it help to protect our environment?

Q. 3 Write short note on the following-

(a) Resettlement and rehabilitation of project affected persons

(b) Bishnoi movement

2.5.9 SUGGESTED READINGS AND WEB SOURCES

1. Environmental Studies - R.R. Das
2. Environmental Education - R.A Sharma
3. https://www.clearias.com/environmental-movements-in-india/
4. https://en.wikipedia.org/wiki/Environmental_communication

Environmental Ethics: Role of Indian and Other Religions and Cultures in Environmental Conservation

Structure

2.6.1 Objectives

After going through this lesson, students will be able to:

1. Understand the concept of environmental ethics
2. Analyse the role of various religions in environmental protection
3. Interrelationship between religion and environment

2.6.2 Introduction

The concern for environment protection can be traced back to the period between 321 and 300 BC. The ancient Indian law on environment protection is found in Kautilya's Arthashatra. It was the dharma of each individual in the society to protect the nature. The people worshipped the objects of nature. The trees, water, land gained important position in the ancient times. The cultural and religious heritage of Indians shows a deep concern for the protection and preservation of the environment.

2.6.3 Environmental Ethics

The explosion of scientific knowledge during the past century and its use in the development of newer technologies being utilized to bring comforts to human beings, have not been responsible to assist in obtaining a comfortable and perpetual life for man, on the contrary it has threatened the survival of human race. The scientific and technological indulgence in nature tends to upset the balance of nature and destroy the very basis for the perpetuation of human species. The world today is charged with technological individualism which ignores the fact that the resources operate as closed system and encourage the rapid use of environmental resources. Schumacher (1974) points out that the existing way of life has no permanence or sustainability and forces it towards environmental and economic destruction.

In the constitution of India,Articles 48A and 51A have been added as 42nd amendment and directive principles of state policy and fundamental duties respectively.

Article 48(A).**Protection and improvement of environment and safeguarding of forests and wildlife.** "State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country."

Article 51A: Fundamental duties: It shall be the duty of every citizen of India–

- to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem
- to cherish and follow the noble ideals which inspired our national struggle for freedom;
- to uphold and protect the sovereignty, unity and integrity of India;
- to defend the country and render national service when called upon to do so;
- to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- to value and preserve the rich heritage of our composite culture;
- to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;
- to develop the scientific temper, humanism and the spirit of inquiry and reform;
- to safeguard public property and to abjure violence;

- to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.
- to provide opportunities for education by the parent the guardian, to his child, or a ward between the age of 6-14 years as the case may be.

Our age old traditions teach us to live in peace and harmony with nature and to conserve it, as we all are creatures of one creator, and we don't have any right to harm, any of the living being in any manner as they are also one of the creations made by the almighty, this is taught to us since the very beginning of our civilization but as the civilization progressed we forgot everything and started thinking that we are the master of nature and everything in this world is made for us and we can utilize it, at any cost , as and when require, this is against our ethics and moral values. Environmental protection includes itself a variety of duties which any human individual has to perform. It is amatter of moral and cultural ethics.

2.6.4 Role of Indian and Other Religions in Environmental Protection

India is a land of rites and rituals. Almost all major religions of the world are represented in India. All the sereligions realized the proximity of mankind with nature. All religions regulated the conduct of mankind in such a manner which was conducive to nature and not adverse to nature. In many parts of India, communities have inherited the rich tradition of love and reverence for nature through ages. Religious preaching, traditions and customs have played a big role in this regard: Indian religions have generally been the advocates of environmentalism. They campaigned for such guidelines to the commoners that ensured an intimate contact and sense of belonging in nature.

2.6.4.1 Hinduism :- In Hinduism, we find that from Vedic period. The environment was part of ethos of ancient people. In Rig Veda it is mentioned that the universe consists of five basic elements. They are earth, water, air, fire and ether (space). These five elements provide basis for life in everything and man is ordained to conserve them. It is further ordained that nobody will destroy vegetation and no one shall kill animals. Thus it shows compassion for both animals and plants. The yajna or sacrifice fire, apparently done to worship one or the other deity, also help in purifying the air and thus keeping the environment healthy. In the Manusmriti also it is stated that the yajna or sacrificial fire is the cause of biological evolution. The sages of the Atharva Veda chanted:-

"What of thee I dig out,
Let that quickly grow over,

Let me not hit thy vital, or
Thy heart"(Ramjilal,56).

This means that one can take from the earth and atmosphere only so much as one puts back to them. In the present days, this is considered one of the most important principles of sustainable development. Atharva Veda speaks about the protection of wild life and domestic cattle. The cattle were meant to adorn the ceremony but not for sacrifice. The killing of animals in the name of yajna has been condemned as mad and in disciplined acts in Mahabharata. Manusmriti also mentions about the optimum use of the resources of the nature. This is yet another way to maintain the ecosystem. Certain trees are considered to be scared and they are worshiped. They are not to be cut. In padmapurana and karma purana, it is mentioned that the trees like, peepal, bel, ber, neemetc, are the abode of god and they are not to be cut. This is nothing but a way of conserving the vegetation. Planting of trees and plants like tulsi in every house are considered to be religious acts. Hinduism considers the nature as "**the body of god".** Thus different aspects of nature, i.e. plants (tulsi), trees (peeple), birds (garuda) and animals (lion) are worshiped. Thus the nature has been directly interconnected with religion and religion had a direct effect on the conservation and protection of environment.

2.6.4.2 Islam :- In Islam the Holy Qur'an and the divinely inspired words ofProphet Mohammed form the foundation of and rules for the conservation of nature. The Holy Qur'an declares that everything is created from water. Allah is considered to be the owner of land and mankind is the trustee or guardian whereas other living creatures are considered to be the beneficiaries. In Islam, the environment is a broad concept. It includes climate and its components, plants, animals, sand, human being, and all things found on the ground or in the atmosphere. All these creatures were created to service the people. Therefore, the people are responsible for maintaining and conserving the environment. Islam forbids wasting of resources and destroying the environment. The Prophet (peace be upon him) ordered the Muslims not to cut trees during the war. He emphasised the conservation of the environment and the prevention of its destruction. Therefore, conserving the environment is a religions duty of every Muslim.

According to the Islamic Educational, Scientific, and Cultural Organisation (ISESCO), water appears in the Holy Quran in over 50 'verses' and 40 'Suras'. In sura Nahl, Verse 65, Allah said, 'And God sends down rain from the skies, and gives therewith to the earth after its death'. Islam considers water as a basic element of life. According to Allah, 'Eat and drink, but waste not be excess' (Al-

araf: 31). Reducing waste can benefit the environment in different ways. For instance, waste reduction reflects the efficient use of natural resources. It also saves the environment from problems caused by waste pollution. Moreover, Islam urges people to clean their bodies, areas, and their surrounding environment. Islam forbids all types of excesses, whether in drinking, eating, and other activities.

2.6.4.3 Buddhism:- The basic tents of Buddhism are simplicity and ahimsa or non-violence. Both these principles of Buddhism are of great importance in the conservation and protection of natural environment. The principle of simplicity teaches us that man should not overexploit the natural resources. Man should not become greedy to earn more and more in the shortest possible time by exploiting the natural wealth and leaving nothing for the future generation. There is sufficiency of everything in the nature of man's need but not for man's greed. Thus the first principle of Buddhism i.e. Simplicity is based on sustainability which is also the crying need of the present times. The other basic principle of Buddhism i.e. ahimsa or non-violence teaches us that we should not kill animals. It shows the love for fauna and flora. In Buddhism we also find emphasis on tree plantation and their preservation. King Ashoka wanted the non-violence to be the cultural heritage of the people. Therefore punishment was prescribed for killing animals.

2.6.4.4 Jainism: - The basic trust of Jainism is on the minimum destruction of living and non-living resources for the benefit of man. People following Jainism also believe in the principle of simplicity i.e. to meet their minimum needs without overexploiting the nature and natural wealth. Thus Jainism is also based on the principle which is in close harmony with nature and help in protecting and preserving the nature.

2.6.4.5 Sikhism: - Sikh religion is comparatively of recent origin. The concern for environment is evident from the fact that it considers every creature to be the incarnation of God and hence conservation and preservation are essential principles. Guru Nanak Ji said

"Air is vital force,
Water the Progenitor,
The vast earth the Mother of all,
Day and night
Are nurses fondling all Creation in their lap" (Dani, 34).

Guru Granth Sahib Ji also emphasis that the human beings are composed of five basic elements of nature that is earth, air, water, fire, and sky. Thus, close

relationship between nature and mankind has been recognized. In Guru Granth Sahib, where air has been designated as the Guru, water the father, the expansive earth has been accepted as the mother in whose lap the whole of the world is entertained by day and night:

"pavanu guru pani pita matadharatimah
ati, divasurati dui daidaia
khelaisagaljagatu."

The earth, in the Guru Granth Sahib is the symbol of the bearing of the sufferings. She for the sake of her children absorbs all sorts of heats in it. The earth never loses its equanimity whether some body digs it or paints it with sandal.

2.6.4.6 Christians:- Christians are baptized in water, as a sign of purification. In fact in almost all religions, a common thread is the secret quality of water. Pope Paul VI, in his message to the united nations conference on the human environment held at Stockholm in June 1972 stated that the environment and resources are for everyone, they are inalienable property of everyone that there does not exist over this universal property discretionary sovereignty exempting from responsibility towards the humanity of today and tomorrow. This message of Pope Paul makes it amply clear that there is a close link between Christianity and environment and the thrust is for sustainable development. The man of today should not exploit the natural resources in such a way so that nothing is left for the coming generations.

2.6.5 Environmental Ethics :

Vedas : Vedic literature (about 1500 BC) clearly speaks that there is an integral balance in Man, Nature and The God. Natural forces were considered to be expressions of the Lord Himself and are venerable entitites. Vedas envisage a beautiful natural environment on earth and command the man not to pollute.

Veda commands the knowledgeable to keep the environment free from all impurities and that can be done by way of Yagnas or sacrificial fire. Yagnas have said to be the medium of relation between human and the Devatas. These Devatas are the natural forces who have to be kept propitiated. The Yagnas are done to worship the deity and to purify the air and keep the environment healthy. The 'vid' has been commanded to devote his life for the purpose of yagnas and thus balancing the interests of man and nature.

Buddhism : Buddha also set down rules forbidding the pollution of rivers, ponds and wells in Sutta-Nipata. Know ye the grasses and the trees… Then know ye the worms, and the different sorts of ants…Know ye also the four-footed

animals small and great... the serpents...the fish which range in the water... The birds that are borne along on wings and move through the air.

The Dalai Lama expressed this clearly in the following way "As a Buddhist I believe in the interdependence of all things, the interrelationships among the whole spectrum of plant and animal life including elements of nature which express themselves as mountains, valleys, rivers, sky and sunshine.

Jainism : This can be done by adhering to three precepts : the right belief, the right knowledge and the right conduct. Everyone should be benevolent towards all living organisms, compassionate for the weak, tolerant of the insolent and joyful at the virtuous.

Christianity : The Christianity also says that harmonic triadic relationship exists between the divine and humanity, among human beings and nature and failure to maintain the harmony may alienate humanity from its creator and also from Nature.

Briefly discuss the role of Islam in environment protection.

_____

_____

What is the importance of Indian religions in protection of environment?

_____

_____

_____

2.6.6 Environment and Indian Culture :

The cultural heritage of India shows a deep concern for the safeguard and conservation of the environment. Indian tradition considered the earth as 'Mother'. Rivers are described Lokmata. India is a land of rites and rituals. Indians have articulated the need to sustain and promote the ecological balances of nature through sacred incarnations and systematized 52 rituals for the sustenance of life on the earth. Since all most all the major world religions are represented in the Indian soil and their religions in turn realized the proximity of mankind and nature, they regulated conduct of mankind in such a way conducive to nature. Indian culture shows an ecological evolution to peace. Peace to all elements of nature and mankind and harmony between them. Thus 'environmentalism' is a part and parcel of the Indian culture.

Briefly describe the impact of culture on environment.

_____

_____

_____

2.6.7 Conclusion:- Thus we can say that though we have rich tradition and culture of living in peace and harmony with nature but with industrialization we have become in different towards nature. Previously there were no laws for conservation of environment in our country other than some indirect laws, as the people of our country loved and respected their fellow organisms. But in the changed scenario as development and pollution went hand in hand, man started using the natural resources so lavishly ,therefore it became very necessary to preserve these resources otherwise there would be no resources left for the future generations to come. Traditional knowledge had always contributed to modern medicine and health care. We have to preserve this aspect of culture and amalgamate it with modern methods to work toward environmental conservation.

2.6.8 Glossary

- **Ethics**: moral principles that govern a person's behaviour or the conducting of an activity.
- **Conservation**: preservation or efficient use of resources

2.6.9 Suggested Questions

1. Briefly describe the concept of environmental ethics.
2. Explain the role of Sikhism in environmental protection.
3. What is the role Hinduism in protection of environment?

2.6.10 Self-Check Exercise

1. According to Rig Veda, the five basic elements of universe are _____.
2. Hinduism considers the nature as body of _____.
3. According to the Holy Quran, everything is created from_____.
4. Muslims should not cut_____ during the war.
5. The basic tents of Buddhism are_____ and _____.

Answers : (1) Earth, Water, Air, Fire and Ether (2) God (3) Water (4) Trees
(5) Simplicity, ahinsa or non-violence

2.6.11 Suggested readings

Author	Book
Baary Commoner	Science and the Survival
MiladAbdelnabiSalem, NorlenaHasnan and Nor Hasni Osman	Some Islamic Views onEnvironmental Responsibility
SubhyaPandey	Environment: Ethics, Laws and its Conservation
BhartiChibbar	Indian Cultural Heritage and Environmental

	Conservation through TraditionalKnowledge
Dr.Jodh Singh	Environmental Concerns & Guru Granth Sahib
CBSE	Indian Traditional Knowledgeon Environmental Conservation
R. R. Das	Environmental Studies

Web Sources

- https://pcdnetwork.org/blogs/indian-environmental-concerns-protection-of-indian-religious-and-cultural-heritage/
- https://paperap.com/paper-on-role-of-religion-in-environmental-conservation/
- https://www.srcc.edu/sites/default/files/Role%20of%20religion%20in%20Environment-Unit%20VII-AECC-EVS-Harvinder%20Singh.pdf
- https://niu.edu.in/sla/online-classes/Environmental-Protection.pdf

Stubble Burning – Meaning, impact of stubble burning on health and environment

Structure

2.7.1 Objectives

After going through this lesson students will be able to-

1. Understand and define the concept of stubble burning.
2. Explain the process of stubble burning in North India.
3. Discuss the reasons of stubble burning in North India.
4. Analyze the side effects of Stubble burning on health and environment.

2.7.2 Introduction

We all know that India is an agricultural driven economy. India is one among the leading countries in the production of wheat, sugarcane and rice etc. Increase in agricultural production simultaneously increased the agricultural waste, which is a major environmental problem of India in recent years. This agricultural waste is known as stubble and is a major issue of concern for the farmers of north India especially Punjab and Haryana. Farmers found burning of this stubble as the easiest way to get rid of the problem of stubble dumping. In this chapter we will discuss about the concept of stubble burning the ill effects of stubble burning on the environment.

2.7.3 Meaning of Stubble burning

Stubble burning can be described as deliberately setting on fire the straw stubble (Parali) that remains after harvesting of wheat and other grains. In north India farmers in Punjab burn the rice residues after harvest so as to quickly prepare the land for wheat plantation. The practice was widespread until the 1990s,. After that governments increasingly restricted its use. Ploughing the stubble back into the ground is a good practice and is ecofriendly. But on the contrary the burning of stubble has a number of consequences and adverse effects on the environment. Smoke from agricultural burning contains numerous substances that can harm human health, including carbon monoxide, nitrogen oxides, and particulate matter.

Effect of Stubble burning:

1. It quickly clears the field and is a cheap process.
2. It kills weeds, including those resistant to herbicide.
3. It kills slugs and other pests also.
4. It can reduce nitrogen tie-up.

On the other hand, harmful effects of stubble burning on the environment are :

1. Because of fire there is loss of nutrients of soil.
2. There is pollution on large scale because of smoke.
3. It damages electrical and electronic equipment due to floating threads of conducting waste.
4. There is always a risk of spreading of fires to the larger area.
5. Stubble burning contributes to increase in atmospheric CO_2

2.7.4 STUBBLE BURNING IN INDIA

India has a major agribusiness sector and is achieving remarkable successes over the last three or four decades. In India more than 50% population is engaged in cultivation of agricultural products. This production just doesn't feed the country but generates enough agriculture products to export to the outside world. In the production of crops such as wheat, rice and sugarcane India is among leading countries. With million tons of agriculture crops producing every year, side by side it is also producing tons of agricultural waste/residue which is made up of organic compounds from organic sources such as rice straw, sugar cane bagasse, coconut shell and others. With high amount of agricultural waste, it becomes difficult for the farmers to dump that waste. With reaping of paddy fields, large quantities of husk are generated that needs dumping. Farmers generally gather husk and put them to fire because for them it is the easiest ways to get rid of husk. But burning husk has several demerits and ill effects on environment and health of human beings (Anant Srivastav).

In north India the Punjab state has two growing seasons: one from May to September and another from November to April. In the month of November wheat and vegetables are sown by the farmers. To clear the field for crop plantation farmers often set fire to their fields before planting. This practice is known as stubble burning. There are two reasons of crop residue burning. First is that at the end of the Kharif season farmers get very less time period between harvesting of paddy and cultivation of wheat. Rice, is a water-intensive crop. Central and various state governments restricted the cultivation of paddy in the summer months because of high usage of water in its cultivation. In order to prevent diversion of scarce water resources in the summer, paddy cultivation can legally begin only around mid-June, when the monsoons typically arrive over North India. This further delays the cut short to the root with a knife, the large units of harvesters leave 6-10 cm of paddy stalk on the field. The rise in incomes and the subsequent availability of mechanical implements in Punjab and Haryana lead to increased mechanization of agriculture over the past 10-15 years. Traditionally, farm labour in these states was in the form of seasonal, migrant workers from the states of Uttar Pradesh and Bihar. Since 2005, the demand for these workers saw a reduction, and accordingly, the availability of assured income from farm labour has declined. The launch of an assured rural income scheme in the form of the NREGA further led to income opportunities in their home states, which resulted in scarcity of agricultural labour in various parts of Punjab (Polash Mukerjee, 2016)

The **removal of the paddy stalk that remains on the field is a labour-intensive process**. With labour being unavailable and the time window for preparing the field for wheat cultivation being limited, the options that the farmer has are either investing in expensive and rarely used agricultural implements, or burning the residue right on the field. Of the two, the latter is both cheaper and requires less effort. As per estimates, Punjab produces approximately 19-20 million tonnes of paddy straw and about 20 million tonnes of wheat straw. Usually 85-90 percent of the paddy is burnt in the field and similarly wheat straw is also being burnt during the Rabi harvesting season. In Haryana the similar problem persist, although the intensity is smaller than Punjab. The estimate paddy straw production is 2 million tonnes. (Polash Mukerjee, 2016)

In north India stubble burning in Punjab has been found as a major cause of air pollution in Delhi. Usually from late September through October of each year, farmers mainly from Punjab and Haryana burn million tons of crop waste from their wheat fields after harvesting. This is a low-cost straw-disposal practice to reduce the turnaround time between harvesting and sowing for the second crop.

Stubble burning produces a cloud of particulates along with smoke and also produce "toxic cloud" which sometimes results in declarations of an air-pollution emergency in north India. Even if harvesters are available such as the Indian-manufactured "Happy Seeder" that shred the crop residues into small pieces and uniformly spread them across the field, as an alternative to burning the crops, but farmers complain that the cost of these machines is unaffordable for them and they prefer to burning the fields.

2.7.5 Objectives of PEDA for Stubble Burning :

The objectives of PEDA in for stubble burning are as follows :

- Promotion, development and implementation of non-conventional energy technologies programs and projects.
- Promotion and development of Biomass/Agro residue based power projects.
- Implementation of a comprehensive energy conservation program in the industrial, agricultural, commercial as well as household sector.
- Promotion and implementation of new technologies for energy saving.
- Collection of energy data base to provide policy and planning input to the state government.
- Measures for improving the combustion efficiency of rice husk fires boilers.
- Analyze the availability and utility of biomass as energy source.
- Installing community/institutional biogas plants.
- Implementation of Integrated Rural Energy Program (IREP)

Punjab Biodiversity Board

Some of the functions of the board in meeting its objective are :

- To promote biodiversity conservation activities in both agriculture and wild areas.
- To implement the provisions of the Biological Diversity Act, 2002 in Punjab.
- To assist setting up of Biological Diversity committee at village and town level and expert committee at the state and district level.

2.7.6 Existing Policies to Control Air Pollution :

The Punjab Pollution Control Board (PPCB), Punjab State Council for Science and Technology (PSCST), Punjab Energy Development Agency (PEDA) (http://www.peda.gov.in/) are the institutions that have been vested with the task of controlling pollution in Punjab.

- Punjab Pollution Control Board (PPCB)
- Agriculture Councils
- Punjab State Council for Science and Technology

- Department of Agriculture
- Punjab Energy Development Agency (PEDA)
- Department of Animal Husbandry
- Punjab Agricultural University
- Punjab State Farmers Commission
- Department of Rural Development and Panchayats
- Agriculture Diversification
- Promotion of Zero Tillage

2.7.7 SIDE EFFECTS OF STUBBLE BURNING ON HEALTH AND ENVIRONMENT

- Stubble (Crop residue) burning is one among the many sources of air pollution. Open burning of husk produces harmful smoke that causes pollution. Open burning of husk is of incomplete combustion in nature. Because of this large amount of toxic pollutants are emitted in the atmosphere. Pollutants contain harmful gases like Methane, Carbon Monoxide (CO), Volatile organic compound (VOC) and carcinogenic polycyclic aromatic hydrocarbons.
  - Burning of farm waste causes severe pollution of land and water on local as well as regional scale.
  - This also adversely affects the nutrient budget in the soil. Straw carbon, nitrogen and sulphur are completely burnt and lost to the atmosphere in the process of burning.
  - It results in the emission of smoke which if added to the gases present in the air like methane, nitrogen oxide and ammonia, can cause severe atmospheric pollution. These gaseous emissions can result in health risk, aggravating asthma, chronic bronchitis and decrease lung function.
  - Burning of crop residue also contributes indirectly to the increased ozone pollution.
  - It has adverse consequences on the quality of soil. When the crop residue is burnt the existing minerals present in the soil get destroyed which adversely hampers the cultivation of the next crop.
  - The on field impact of burning includes removal of a large portion of the organic material. The off field impacts are related to human health due to general air quality degradation resulting in aggravation of respiratory (like cough, asthma, bronchitis), eye and skin diseases.

- The black soot generated during burning also results in poor visibility which could lead to increased road side incidences of accident. Clouds of ash and smoke can travel more than thousand kilometers and create an obstinate and non-clearing clouds. Smog formed of the smoke can increase the levels of pollutants by manifolds in the air, making it difficult to breathe. After release in the atmosphere, these pollutants disperse in the surroundings, may undergo physical and chemical transformation and eventually adversely affect the human health. Frequent husk burning may contribute to the formation of the brown clouds that affects the local air quality, atmospheric visibility and earth climate.
- Some think burning is a quick, easy and cheap method as all unwanted husk, plants and shrubs gets destroyed. Some believe that fire may return nutrients to the land. But burning husk on ground destroys the nutrients in the soil, making it less fertile. Heat generated by stubble burning penetrates into the soil, leading to the loss of the moisture and useful microbes. Thus adversely affecting the soil. It kills natural nutrients and bacteria that helps rejuvenate soil.
- The burning of paddy or stubble leads to the loss of precious nutrients as nearly 25% nitrogen and phosphorus, 50% Sulphur and 75% potassium uptake from the soil are retained soil residues. It is estimated that burning of 1 Ton of stubble or paddy straw accounts for loss of 5.5 kg nitrogen, 2.3 kg phosphorus, 25 kg Potassium and 1.2 kg Sulphur, besides organic carbon.
- Husk has high prolific value. Rice husk is unusually high in ash, which is 92-95% silica, highly porous and lightweight, with a very high surface area. Its absorbent and insulating properties are useful in many industrial applications, such as acting as strengthening agent in building materials. Husk is also produced as fuel for processing paddy, production through direct combustion or gassification. It is also used as cattle feed. Burning stubble would be a waste of such utility.
- On November 9, 2013, the *Times of India* reported that smoke was heavy enough in Chandigarh to ground a handful of flights. In addition, engineers from the Indian Institute of Technology recently published a report noting that air pollution posed a threat to the Harmandir Sahib (Golden Temple), an historically-significant religious site in Amritsar**.**
- The pollutuion created by stubble burning also cause lung cancer
- It also leads to various Heart diseases among human beings.

Punjab Government, its various Departments and other institutions like Punjab Agricultural University, Punjab Farmers Commission are all making efforts to devise some alternate economic uses of rice stubble. These include the stubble treated with urea as a fodder for animals, its use in biothermal energy production, paper manufacturing, mushroom cultivation, bedding for animals, etc.

Punjab government is also providing subsidy to the farmers to promote the use of equipments which help in checking the burning of crop residues, like rotavators, happy seeders, zero–till-drills and straw reapers.

There is an urgent need to revitalize the research in agriculture and related activities to tackle the problem of soil degradation and water depletion, a dedicated programme for promoting resource conservation technologies, such as zero tillage, deep ploughing, raised bed planting, laser land leveling etc., should be promoted. An eco friendly technology will be beneficial to the farmer community and the state by providing them a tool for improving soil health and environment for sustainable agriculture (Parmod Kumar and Laksmi Joshi, 2013, research gate).

2.7.8 VARIOUS ALTERNATIVES OF STUBBLE BURNING:

1) To collect stubble stubble collecting machines should be provided to farmers.
2) Stubble collecting machines should be given at rent to the farmers.
3) Providing reasonable labor to reap the paddy to avoid stubble generation. This will provide temporary employment to people in need.
4) Cattles should be allowed to graze or feed upon to clear away husk and stubble.
5) One of the important alternative is decomposition of stubble in the farm field and turning it into the useful manure.
6) Collected stubble could be used for making fodder for livestock.
7) Setting up Bio-mass fuel plants to generate fuel using paddy husk.
8) Government should make provisions for the involvement of benefiting industries like cement industry to collaborate in husk/hull or stubble collection to use it proficiently.
9) Provisions should be made to invite packaging industries to collect stubble to make packaging boxes which are more environment friendly than other non-disposable materials like thermocole and plastic.

2.7.9 Summary

India is one of the leading countries in the production of rice and wheat etc. On the one hand where increased agricultural production is playing an important role in boosting the economy of India, simultaneously on the other hand it is

producing tons of agricultural residue also and making it very difficult for the farmers to tackle the problem of dumping this waste. To deal with this problem farmers generally collect the husk and burn it. They found it as the easiest way to tackle the problem. This burning of agricultural residue is known as stubble burning.

2.7.10 Suggested Questions

Q. 1 What do you mean by stubble burning? Discuss the impact it is posing on the environment ?

Q. 2. Discuss in brief the effect of stubble burning on the health of human beings in north India.

2.7.11 Suggested Readings and used web sources

1. Stubble Burning: Side effects and Possible alternatives - https://ballotboxindia.com/dp/Stubble-burning-side-effects-and-its-alternatives/5182318549/
2. Stubble Burning in Northern India - https://www.earthobservatory.nasa.gov/images/82409/stubble-burning-in-northern-india
3. https://www.jagranjosh.com/
4. https://www.researchgate.net/publication/278697280_Pollution_Caused_by_Agricultural_Waste_Burning_and_Possible_Alternate_Uses_of_Crop_Stubble_A_Case_Study_of_Punjab

Lesson No. 2.8 **Writer : Nipunta Kaur**

Stubble burning: Management and alternative uses of crop stubble, environmental legislation and policies for restriction of agriculture residue burning in Punjab

Structure

2.8.1 Introduction

Stubble burning is a serious issue of now days especially in Punjab. It adversely affects the health of human beings, animals also as well as environment. There are some other ways to manage the crop residue naturally as well as scientifically. Government of India made several policies and laws related to crop residue management. It is the state of Punjab also who continuously make efforts and give directions to farmers and agriculture institutions to use agriculture residue in other areas instead of burning it. In this chapter we will discuss the ways to manage crop residue and policies made by Punjab government to stop stubble burning.

2.8.2 Objectives:

After going through this lesson students will be able to:

i. Understand the need to stop stubble burning
ii. Explain the ways to manage crop residue
iii. Understand the laws relating to stubble burning

2.8.3 Management and alternative uses of stubble burning

Paddy straw is a major field-based residue that is produced in large amounts inAsia. However, an increasing proportion of this paddy straw undergoes field burning. Punjab produces around 23 million tonnes of paddy straw and 17 million tonnes of wheat straw annually. More than 80 % of paddy straw (18.4 million tonnes) and almost 50 % wheat straw (8.5 million tonnes) produced in state is being burnt in fields. As per latest data provided by Central Ground Water Board,(Government of India 2011) and Department of Irrigation Punjab, out of 137blocks of the state, 103 blocks are overexploited, 5 blocks are critical, 4 blocks are semi critical and only 25 blocks are in safe category. All the blocks of various districts like Amritsar (16 blocks), Jalandhar (10 blocks), Moga (5 blocks), Kapurthala (5 blocks), Sangrur (12 blocks), Fatehgarh Sahib (5 blocks), Patiala (8out of 9 blocks) and Ludhiana (9 out of 10 blocks) have been found to be over exploited, leading to sharp depletion of the water table in these districts. Agricultural waste includes paddy and wheat straw, cotton sticks and animal waste. Keeping in view the increasing problems associated with crop stubble burning several initiatives for its proper management have been taken up. Various departments and institutions are promoting alternative uses of straw instead of burning. These include:

2.8.3.1 Use of Rice Residue as Fodder for Animals

The rice residue as fodder for animals is not a very popular practice among farmers in Punjab. This is mainly because of the high silica content in the rice

residue. It is believed that almost 40 % of the wheat straw produced in the state is used as dry fodder for animals. However to encourage the use of rice residue as fodder for animals, a pilot project was taken up by PSCST at PAU under which trials on natural fermentation of paddy straw for use as protein enriched livestock feed were conducted. The technology was demonstrated in district Gurdaspur, Ludhiana, Hoshiarpur and Bathinda. The department of Animal Husbandry, Punjab has propagated the technology in the state

2.8.3.2 Use of Crop Residue in Bio Thermal Power Plants

Another use of rice residue that is being encouraged by various institutions and departments is the use of rice residue for generation of electricity. A 10 MW biomass based power plant at village Jalkheri, Fatehgarh Sahib with paddy straw as fuel was set up in the year 1992.

2.8.3.3 Use of Rice Residue as Bedding Material for Cattle

The farmers of the state have been advised to use paddy straw as bedding material for cross bred cows during winters as per results of a study conducted by the Department of Livestock Production and Management, College of Veterinary Sciences, Punjab Agricultural University. It has been found that the use of paddy straw bedding during winter helped in improving the quality and quantity of milk as it contributed to animals' comfort, udder health and leg health. Paddy straw bedding helped the animals keep themselves warm and maintain reasonable rates of heat loss from the body. It also provides clean, hygienic, dry, comfortable and non-slippery environment, which prevents the chances of injury and lameness. Healthy legs and hooves ensure enhancement of milk production and reproductive efficiency of animals. The paddy straw used for bedding could be subsequently used in biogas plants. The use of paddy straw was also found to result in increased net profit of Rs. 188–971 per animal per month from the sale of additional amount of milk produced by cows provided with bedding.

2.8.3.4 Use of Crop Residue for Mushroom Cultivation

Paddy straw can be used for the cultivation of Agaricus bisporus, *Volvariella Volvacea* and Pleurotus spp. One kg of paddy straw yields 300, 120–150 and 600 g of these mushrooms, respectively. At present, about 20,000 metric tonnes of straw is being used for cultivation of mushrooms in the state. Paddy straw mushroom accounts for 16 % of total production of cultivated mushroom in the world.

2.8.3.5 Use of Rice Residue in Paper Production

The paddy straw is also being used in conjunction with wheat straw in 40:60 ratios for paper production. The sludge can be subjected to bio-methanization for energy production. The technology is already operational in some paper mills, which are meeting 60 % of their energy requirement through this method. Paddy straw is also used as an ideal raw material for paper and pulp board manufacturing. As perin formation provided by PAU, more than 50 % pulp board mills are using paddy straw as their raw material.

2.8.3.6 Use of Rice Residue for Making Bio Gas

The PSFC has been coordinating a project for processing of farm residue into biogas based on the technology developed by Sardar Patel Renewable Energy Research Institute (SPRERI). A power plant of 1 MW is proposed to be set up at Ladhowal on pilot basis on land provided by PAU. The new technology will generate300 m3 of biogas from 1 t of paddy straw.

2.8.3.7 In Situ

The technical measures are 'straw incorporation' and 'straw mulching'. In both these measures, the residue is incorporated in the field itself and is thus used to increase the nutrient value or fertility of the soil. In the first measure, the residue is allowed to decompose in the field itself through a chemically developed process(available at PAU), and in the second measure, incorporation is done with the help of a properly designed machine along with seeding (know-how developed at PAU). The second measure is more useful as there is no weeding in this process and it is less expensive.

2.8.3.8 Incorporation of Paddy Straw in Soil

The incorporation of the straw in the soil has a favorable effect on the soil's physical, chemical and biological properties such as pH, Organic carbon, water holding capacity and bulk density of the soil. On a long-term basis it has been seen to increase the availability of zinc, copper, iron and manganese content in the soil and it also prevents the leaching of nitrates. By increasing organic carbon it increases bacteria and fungi in the soil.

2.8.3.9 Production of Bio-oil from Straw and Other Agricultural Wastes

Bio-oil is a high density liquid obtained from biomass through rapid pyrolysis technology. It has a heating value of approximately 55 % as compared to diesel. It can be stored, pumped and transported like petroleum based product and can be combusted directly in boilers, gas turbines and slow and medium speed diesels for heat and power applications, including transportation.

2.8.4 Environmental Legislations and policies for restriction of agriculture residue burning in Punjab

2.8.4.1 Ministry of Environment and Forest

The Ministry of Environment and Forest (MoEF) is a nodal agency in the administrative setup of the Union Government. The Ministry is entrusted with the task of planning, coordinating, overseeing and implementing various forestry and environment programmes. The Ministry undertakes various activities like prevention and control of pollution, conservation and survey of flora and fauna, forests and wildlife, protection of environment etc., in the framework of legislations.

The MoEF has constituted a number of pollution control acts for the prevention, control and abatement of different types of pollution in India. These acts are:

- The National Environment Tribunal Act, 1995 (27 of 1995).
- The National Environment Appellate Authority Act, 1997 (22 of 1997).
- The Water Prevention and Control of Pollution Act, 1974 (6 of 1974).
- The Water (Prevention and Control of Pollution) Cess Act, 1977 (36 of 1977).
- The Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981).
- The Environment (Protection) Act, 1986 (29 of 1986).
- The Public Liability Insurance Act, 1991 (6 of 1991).

2.8.4.2 Punjab Pollution Control Board (PPCB)

The Punjab Pollution Control Board (PPCB) was constituted in the year 1975, under Section 4 of the Water (Prevention and Control of Pollution) Act, 1974. The PPCB is the main governing body in Punjab for ensuring that the national ambient air quality standards are met. The PPCB has three zonal offices and twelve regional offices. The PPCB has constituted the following cells for the effective implementation of the policies and decisions taken by the Board:

- Consent Management Cell
- Administrative Cell
- Finance and Accounts Cell
- Legal Cell
- Scientific Cell
- Hazardous Wastes Management Cell
- General Planning and Computer Cell
- Construction Cell
- Computer Section.

The Punjab Pollution Control Board abides by the following Acts for the control of environment pollution in the state of Punjab:

- *The Water (Prevention and Control of Pollution) Act, 1974 as amended till date.*
- *The Water (Prevention and Control of Pollution) Cess Act, 1977.*
- *The Air (Prevention* and Control of Pollution) Act, 1981 as amended till date.

In addition to the above Acts, the Ministry of Forests and Environment has also laid down the following rules for the management of hazardous wastes, Bio-medical waste, solid waste management, recycled plastic, used batteries, noise pollution control and protection of the ozone layer under the environment. The objectives of the Punjab Pollution Control Board in pursuing its objective of abating and preventing pollution in Punjab are as follows:

- To control pollution at source with due regard to techno-economic feasibility for liquid effluents as well as gaseous emissions.
- To ensure that natural waters are not polluted by the discharge of untreated city sewage.
- To maximize the reuse of sewage and trade effluents and to use the treated effluent for irrigation and for industrial purposes.
- To minimize pollution control requirements through judicious location of new industries and relocation of industries wherever necessary.
- To control and minimize the pollution of air and water and to maintain the quality of air and water for designated use and purposes.

2.8.4.3 Punjab State Council for Science and Technology

The Punjab State Council for Science and Technology was established on 21 July1983, with the objective of infusing scientific knowledge in the minds of people. The institute has been trying to achieve this through various means of display and publications, about the nature of life while signifying the useable aspects of available technologies. Some of the main objectives of the institute include the following:

- Conservation of environment
- Pollution Control in the state of Punjab
- Providing consultation to various industrial units for undertaking development.

The institute tries to achieve these objectives by working towards the development of new technologies, providing technical support to the state government on development through development of science and technology etc. The institute focuses in providing both formal and informal assistance to the industrial and agricultural sector in carrying out their activities, in such a

manner to ensure judicious utilization of natural resources with the least stress on the environment.

2.8.4.4 Environment Division

The division of environment assists the State Department of Environment, Government of Punjab in technical matters pertaining to environment, identification of major areas of ecological concern, defining the state government policies and plans on various environmental issues, coordinating and monitoring schemes related to environment, creating environmental awareness and promoting environmental education, training and research. It is also implementing projects and programmes related to environment for international bodies like, UNESCO, UNDP, etc., as well as, programmes of the Ministry of Environment and Forests at the national level.

2.8.4.5 Punjab Energy Development Agency (PEDA)

The Punjab Energy Development Agency was established in the year 1991, for the promotion and development of non-conventional and renewable energy programs or projects in the state of Punjab.

The projects undertaken by PEDA to meet its above objectives include the following:

- Mini hydel power generation.
- Solar energy based power generation projects.
- Biomass, Agro based power generation projects.
- Power generation from urban, industrial waste.
- Promotion and development of co-generation.
- Integrated rural energy program (IREP).
- Community institutional/Night soil biogas plants.
- National project on biogas development program.
- Solar Photovoltaic (SPV) water pumping systems.
- Solar cooker implementation program.
- Biomass gasification program.
- National program on improved chulah.
- Energy conservation study/feasibility study/Energy audit in the industry andother user sectors.
- Solar passive architecture–PEDA office complex.
- Power generation potential from non-conventional energy sources.

2.8.4.6 Punjab Biodiversity Board

The Punjab Biodiversity Board was notified in the state in December 2004 under section 22 of the Biological Diversity Act, 2002, to protect Punjab's natural

ecosystems and its flora and fauna. The Board has been set up in the Department of Environment to ensure that biodiversity in both wild and cultivated areas are properly protected. Under the Act, no corporate body or association can commercially utilize the state's biodiversity without approval of State Biodiversity Board.

Further, no foreigner without the approval of the National Biodiversity Authority (NBA) can obtain any biological sample or knowledge associated for research or for commercial utilisation or for bio-survey and bio-utilisation. These include wild relatives of crop species also.

2.8.5 Summary

Residue burning is a serious issue. Government has started various projects to stop it. It is the duty of the individual also to manage the crop residue and use the techniques recommended by the government to manage the crop residue so, that quality of the soil can be improved.

2.8.6 Glossary

- Straw: - Agriculture by product consisting of dry straw of cereal plants after the grain and chaff have been removed.
- Stubble Burning: - Use of controlled fire to clear the crop residue.

2.8.7 Suggested Questions

1. What are the measures taken by Punjab Government to prevent stubble burning?
2. What are the alternatives to manage crop residue.
3. Briefly describe the policies made by government to prevent residue burning.

2.8.8 Self-Check Exercise

1. The Punjab Pollution Control Board was set up in the year_____.
2. The _____agency was established in the year 1991.
3. Punjab Biodiversity Board was formed to protect_____.
4. A _____ MW biomass power plant at Fatehgarh Sahib with paddy straw as fuel was set up in year 1991.
5. Use of paddy straw budding helps in improving _____ and _____ of milk.
6. The incorporation of paddy straw in soil has effect of soil's _____, _____ and _____ properties.

   Answers : (1) 1975 (2) Punjab Energy Development (3) Punjab's natural ecosystem (4) 10 (5) quality; quantity (6) physical, chemical, biological

References

- Pramod Kumar and Surender Kumar: Alternative Uses of Crop Stubble
- Pramod Kumar, Surender Kumar and Laxmi Joshi: Socioeconomic and Environmental Implications of Agricultural Residue Burning A Case Study of Punjab, India