BHARATHIDASAN UNIVERSITY

TIRUCHIRAPPALLI – 620 024

CENTRE FOR DISTANCE EDUCATION

ENVIRONMENTAL EDUCATION

B.Ed. II YEAR

Chairman

Dr.V.M.Muthukumar

Vice-Chancellor

Bharathidasan University

Tiruchirapplli-620 024

Vice-Chairman

Dr.C.Thiruchelvam

Registrar

Bharathidasan University

Tiruchirapplli-620 024

Course Director

Dr. R. Babu Rajendran

Director i/c

Centre for Distance Education

Bharathidasan University

Tiruchirapplli-620 024

Course Material Co-ordinator

Dr.K.Anandan

Professor & Head, Dept .of Education

Centre for Distance Education

Bharathidasan University

Tiruchirapplli-620 024

Author

Dr.B.Saminathan

Asst.Professor,Dept.of Education,CDE

Bharathidaan University

Tiruchirapplli-620 024

The Syllabus adopted from 2015-16 onwards

CONTENTS

ENVIRONMENTAL EDUCATION

OBJECTIVES

After the completion of this course the student teacher will be able

1. To understand the concept of environment ecology and Education.
2. To grasp the significance of environmental education.
3. To understand the nature and scope of environmental education with regard to Indian policies.
4. To have faith in conservation of bio-diversity and understand population and environment.
5. To understand the international effort and environment.
6. To know environmental laws and grasp the concept of environmental legislation and its application in international environmental agreement.
7. To appreciate the concern of environmental agreement.
8. To appreciate the concern of environment research programme.

COURSE CONTENT

Unit-I: Introduction to Environmental Education

Meaning and scope – Importance of Environmental Education - incorporating E.E at various levels- Primary, Secondary and Higher Secondary levels. Education about environment**:**
Environment and Ecological factors – climate; Ecosystem – Structure and functions - Major ecosystems – aquatic and terrestrial system - Energy and its flow in ecosystem.

Unit-II: Environmental problems and protection

Environmental pollution and its consequences – Air pollution, water pollution, land pollution, nuclear pollution, Ozone depletions - Urbanization and its impacts on environment - Deforestation and its impacts on environment – Ways of protecting, Management of Environment, Preserving and Restoring of environment.

Unit-III: India and Environmental Issues and Policies

Environmental Awareness – Environmental problems of India - Environmental ethics - Nature conservation education movement – Social forestry scheme. Conservation of biodiversity :Meanings and need conservation of natural resources – soil, forest, water and wildlife In-situ conservation -National parks and sanctuaries – Biosphere Reserves –Man and Biosphere programme (MAP) –Ex –situ conservation, in –situ conservation, IUCN Red list categories, hot spots.

Unit-IV: Human population and environment

Population growth, Indian population situations population explosion – family welfare programme – Environment and Human health.-Factors affecting environment-Acid rain, green house effect-Extinction of species-soil erosion and energy crisis.

Unit-V: International Efforts for Environmental Protection

The Stockholm conference 1972 – Brundtland commission 1983 – Nairobi conference 1982 – The Rio Summit 1992 – the Rio Declaration at the earth charter – Major achievement of the Rio Summit – Main features of the Rio Declaration – Kyoto conference and part on Global Warming 1997 – present developments.

Unit-VI: Environmental laws in India

Environmental Legislation, Acts, Rules, Notifications and Amendments. International Environmental Agreements. Role of mass media and technology in developing awareness about environmental problems and its prevention; Role of NGO's and Government organization in developing Environmental education. Environmental Movements and Developments : Environmental movements in India: Silent Valley movement, Chipko movement, Narmada Bachao, Andolan, National Test Range at Balipal, Orissa. - Conditions for achieving the goals of sustainable development Strategies for sustainable development in India.

Unit-VII: Environment research programme

Environmental Management – Data base Management for Environmental appraisal, Monitoring and warning system. Society, culture and environment**:** Meaning – Changes of Values, cultural values, aesthetic values, man and environment, the nature of scientific conclusions, the state of public knowledge of ecology, rights and responsibilities in ecology understanding.

Practicum

- Make a survey of your area and document all the environmental problems found along with photographs
- Conduct a survey of five high schools and describe the steps to be taken to enhance the environment and make the institutions Swatch.
- Organize a Rally in a school where you attend Internship on Swatch Bharath and Importance of Environment (The World Environment Day is 5th June) and report
- Conduct elocution and essay writing competitions for students on environmental issues and report

REFERENCES

AGARWAL S.K. (1997). Environmental Issues themes New Delhi: APH Publishing Corporation.

C.E.E (1994) Essential Learning in Environmental Education. Ahmadabad. C.E.E. Publication

Garg, B. & Tiwana. (1995) Environmental Pollution and Protection, Deep & Deep publication, New Delhi.

Karpagam M. (1991) Environmental Economics – A text book. New Delhi. Sterling Publishers.

Kelu.P (2000) Environmental Education – A conceptual Analysis Calicut: Calicut University

Nanda V.K. Environmental Education, New Delhi: Anmol Publications PVT LTD.

N.C.E.R.T (1981) Environmental Education of the school level. A lead paper. New Delhi NCERT publication.

INTRODUCTION TO ENVIRONMENTAL EDUCATION

UNIT -1

STRUCTURE

1.1 INTRODUCTION

Environmental education enables learners to develop a structure of knowledge about the world and seek knowledge that they can use and develop throughout their lives. Environmental education empowers learners by enabling them to participate in a sustainable future. Thus the foundation for a lifelong learning is laid by environmental education.

1.2 OBJECTIVES

At the end of this unit you will be able to

- Define the concept of environment, environmental science and eco-system
- Explain the objectives of the environmental education
- Identify the historical development of the branch eco-system
- Establish the relationship between eco-system and economic development
- Understand the socio-economic concept of degradation of environment

1.3 MEANING OF ENVIRONMENTAL EDUCATION

Environment is derived from the French word “Environner”, which means encircle or surrounding. Environment is a complex of many variables, which surrounds man as well as the living organisms. Environmental education describe the interrelationships among organisms, the environment and all the factors, which influence life on earth, including atmospheric conditions, food chains, the water cycle, etc. It is a basic science about our earth and its daily activities, and therefore, this science is important for everyone.

1.4 SCOPE OF ENVIRONMENTAL EDUCATION

Environmental education discipline has multiple and multilevel scopes. This study is important and necessary not only for children but also for everyone. The scopes are summarized as follows:

1. The study creates awareness among the people to know about various renewable and nonrenewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.

2. It provides the knowledge about ecological systems and cause and effect relationships.

3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganisms in the environment.

4. The study enables one to understand the causes and consequences due to natural and induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.

5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.

6. The study enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.

7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.

8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.

9. It teaches the citizens the need for sustainable utilization of resources as these resources are inherited from our ancestors to the younger generation without deteriorating their quality.

10. The study enables theoretical knowledge into practice and the multiple uses of environment.

1.5 IMPORTANCE OF ENVIRONMENTAL EDUCATION

Environmental study is based upon a comprehensive view of various environmental systems. It aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems. The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and antrosphere.

Importance

1. World population is increasing at an alarming rate especially in developing countries.
2. The natural resources endowment in the earth is limited.
3. The methods and techniques of exploiting natural resources are advanced.
4. The resources are over-exploited and there is no foresight of leaving the resources to the future generations.
5. The unplanned exploitation of natural resources lead to pollution of all types and at all levels.
6. The pollution and degraded environment seriously affect the health of all living things on earth, including man.
7. The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to save the earth.
8. Education and training are needed to save the biodiversity and species extinction.
9. The urban area, coupled with industries, is major sources of pollution.
10. The number and area extinct under protected area should be increased so that the wild life is protected at least in these sites.
11. The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
12. The study motivates students to get involved in community action, and to participate in various environment and management projects.
13. It is a high time to reorient educational systems and curricula towards these needs.
14. Environmental education takes a multidisciplinary approach to the study of human interactions with the natural environment.
15. Environmental study is a key instrument for bringing about the changes in the knowledge, values, behaviors and lifestyles required to achieve sustainability and stability within and among countries.

Environmental education deals with every issue that affects an organism. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human

impacts on its integrity. It is an applied science as it seeks practical answers to making human civilization sustainable on the earth's finite resources.

1.6 NEED FOR ENVIRONMENTAL EDUCATION

The need to protect the environment hence the rationales for environmental education arise as a result of the following:

1. Environment is the basis of all life and therefore deserves proper care and management.

2. If the environment is threatened on a continuous basis, numerous problems which would constitute a danger to human existence could arise.

3. The environment is part of our cultural heritage which should be handed down to prosperity.

4. Some resources of the environment are not easily replaceable and should be managed on a sustainable basis, to prevent the extinction of certain components of the environment such as plants and animals.

5. There is need to enhance the sanity and aesthetic quality of our environment in order to promote healthy living.

6. The environment is part of nature and needs to be preserved for its own sake.

1.7 RATIONALE FOR ENVIRONMENTAL EDUCATION

The rationale for environmental education can be summarized as the following:

1. A major goal of environmental education in India as entrenched in National Policy on Education is the provision of the expertise that can utilize scientific knowledge towards the preservation and solution of environmental problems. Knowledge about the changes that have altered the environment - land, water, weather, and vegetation; social, cultural and political environment are essential components of environmental education. Consequently, the general public should be equipped with all these to be able to solve the problems of the environment.

2. India’s socio-economic development (like any other less developed country) is firmly rooted on the exploitation of the natural resources in our environment. Land, water, forest and other

mineral resources utilization is the dominant feature of rural economy with agriculture the driving force. Uncontrolled and improper exploitation of these resources have implications on the environment causing disruption in the living standard, starvation, displacement and human suffering. Environmental Education is therefore necessary to create awareness of the causes and effects of these problems vise: food and water scarcity, pollution, outbreak of epidemics and natural disaster such as flood, erosion and desert encroachment.

3. Environmental education is needed to foster international co-operation and understanding. The developed countries rely on the high technology for the exploitation of natural resources while developing countries like India totally depend on agriculture, forestry and the mineral resources thereby leading to intensive and over-exploitation of the natural resources and these have serious implications on the resources.

4. Public enlightenment on the impact of government policies on local environment should be useful both to the government and the local people.

5. Awareness of such global environmental issues is an essential component of environmental education which ordinary citizen should be aware of.

6. Environmental education for the over-all social and economic emancipation of women and children. These form a substantial percentage in the utilization of natural resources especially at the rural setting.

7. Environmental education is very essential for the lack of it. Environmental Education is virtually a new thing in this part of the world.

8. Environment education is also very essential for our survival on earth. The natural resources and cultural heritage need to be protected not only for this generation but for future generation.

1.8 GUIDING PRINCIPLES OF ENVIRONMENTAL EDUCATION

1. Consider the environment in its totality, natural and built technological and social structures (economic, political, technological, cultural, historical, moral and aesthetic).

2. Environmental education to be a continuous life saving process (beginning at the pre-school level continuing through all formal and non-formal stages).

3. Environmental education to be interdisciplinary in its approach.

4. Examine major environmental issues from local, national and international point of view.

5. Environmental education to focus on current and potential environmental situations.

6. Promote the values and necessity of local, national and international cooperation in the prevention and solution to environmental problems.

7. Explicitly consider environmental aspects of plan for development and growth.

8. Enhance the position of learners in making decision concerning their environment and accept responsibility.

9. Enable learners to discover symptoms and real and potential causes of environmental problems.

10. Enhance the learners' ability to develop critical thinking and problem solving skills.

11. Utilize different learning environment and approaches to learning/teaching about and form of the environment with emphasis on first hand information.

1.9 OBJECTIVES OF ENVIRONMENTAL EDUCATION AT SCHOOL

i. Objectives of Environmental Education at Primary Level

(a) To know and understand true aspects of the environment in general.

(b) To know and understand the interaction between mammals, between human and their environment and interaction between the various elements and components of the environment.

(c) Build understanding, awareness and sensitivity towards causes and efforts of the class that continuously take place in society the world around us.

(d) To build and develop skills in thinking, reasoning, enquiring, evaluating and making decisions concerning human and the world around them.

(e) Inculcate the attitude in using the knowledge and skills towards solving problem and issues related to individuals, society and the environment.

(f) To build the values and attitudes towards the need and necessity to live together in harmony in the context of the heterogeneous society.

Focus

1. Human, animal and plants undergo a number of life-processes.

2. Human, animals and plants are continuously adapting themselves to the environment.

3. Human alters and modifies the environment with great caution and came in order to fulfill numerous living needs.

4. Identification between human and nature and between environmental elements giving rise to various phenomena which affect them.

5. Society would take active steps to conserve the environment and the balance of nature through careful plans and processing.

ii. Objectives of Environmental Education at Secondary Level

Environmental education to be taught as integrated science in which environmental education concepts are included.

Objectives

1. To emphasize the relevance of science to daily life.

2. To develop a scientific attitude in student.

3. To create an environmental conducive to greater reliance on the use of principles and practices of science.

4. To acquaint the student's with various natural phenomena.

5. To develop an outlook which emphasizes the method employed in different disciplines of science.

iii Aspects of Environmental Education Emphasized at Higher Secondary Level

(a) Population - growth, arises and problems of unplanned population.

(b) Law - Land use, land reclamation and land and soil conservation.

(c) Resources - resource uses, conservation, recycling.

(d) Food and Nutrition - Food production, food adulteration and preservation, balance diet etc.

(e) Conservation - Causes of wildlife, plant, soil, water and conservation of other non-renewable natural beauty.

(f) Pollution - Pollution of water, air and soil, noise pollution, pollution by insecticide and other chemicals and waste disposals.

(g) Health and Hygiene - Individual, family, country and social health and hygiene, health hazards etc.

(h) Humans and Nature - Other compounds of atmosphere, environmental quality and future on earth.

Constraints to Implementing Environmental Education

1. Rigid Specialization.

2. Complexity of inter-disciplinary value of Environmental education.

3. High pupil - teacher ratio for organizing pupil participation programs.

4. Paucity of qualified trained environmental educator.

5. Lack of proper resources in terms of equipment, supplementary materials and reference materials.

6. Tendency to resist changes.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

i) The meaning of the word 'Environment' is ----------

ii) Give the name of any two constraints in implementing Environmental Education

(a) ----------

(b) ----------

iii) The gaseous envelop surrounding the earth is known as ----------

iv) Which of the following is not influenced by human activities

(a) Depletion of ground water (b) Destruction of forest

(c) Exhausting fossil fuel (d) None of the above

1.10 ECOSYSTEMS: DEFINITION, CONCEPT, STRUCTURE AND FUNCTIONS

Ecology is the science that deals with the relationships between living organisms with their physical environment and with each other. Ecology can be approached from the viewpoints of (1) the environment and the demands it places on the organisms in it or (2) organisms and how they adapt to their environmental conditions. An ecosystem consists of an assembly of mutually interacting organisms and their environment in which materials are interchanged in a largely cyclical manner. An ecosystem has physical, chemical, and biological components along with energy sources and pathways of energy and materials interchange. The environment in which a particular organism lives is called its habitat. The role of an organism in a habitat is called its niche.

For the study of ecology it is often convenient to divide the environment into four broad categories.

1. Terrestrial environment - The terrestrial environment is based on land and consists of biomes, such as grasslands, one of several kinds of forests, savannas, or deserts.
2. Freshwater environment - The freshwater environment can be further subdivided between *standing-water habitats (*lakes, reservoirs) and *running-water habitats (*streams, rivers).
3. Oceanic marine environment - The oceanic marine environment is characterized by saltwater and may be divided broadly into the shallow waters of the continental shelf composing the neritic zone
4. Oceanic region - The deeper waters of the ocean that constitute the oceanic region.

Two major subdivisions of modern ecology are

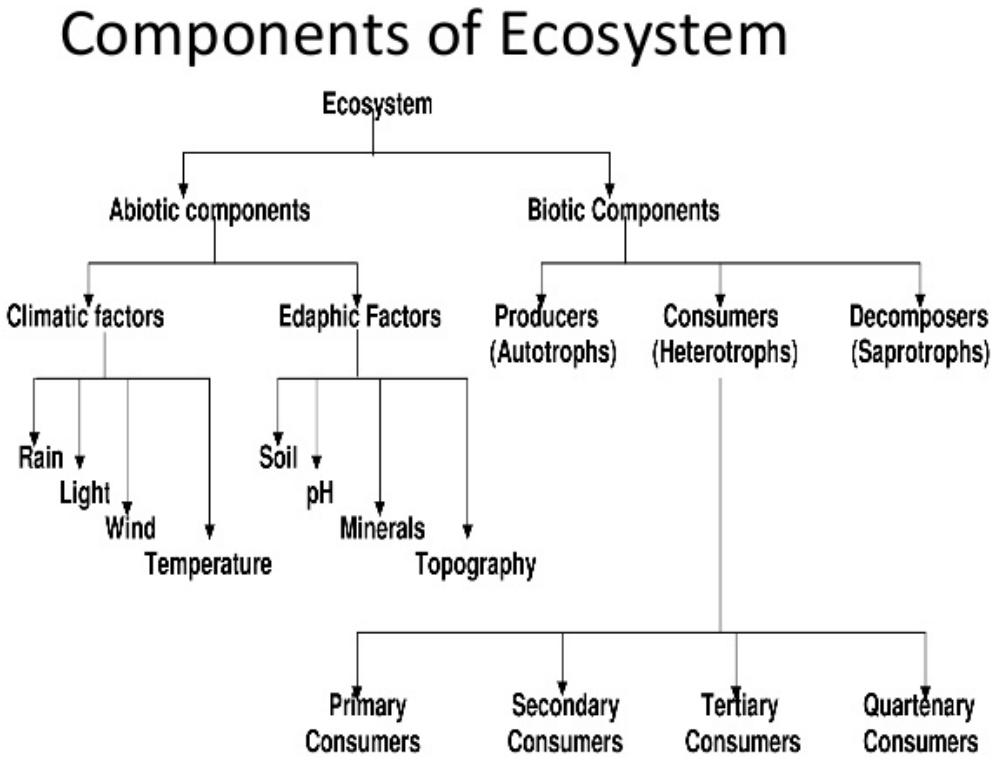
- Ecosystem ecology - which views ecosystems as large units, and
- Population ecology - which attempts to explain ecosystem behavior from the properties of individual units.

In practice, the two approaches are usually merged. Descriptive ecology describes the types and nature of organisms and their environment, emphasizing structures of ecosystems and communities and dispersions and structures of populations. Functional ecology explains how things work in an ecosystem, including how populations respond to environmental alteration and how matter and energy move through ecosystems.

Ecosystems are broadly divided into natural and artificial. *Natural ecosystems* are those that are exist in nature; they are further classified into terrestrial and aquatic. *Terrestrial* includes hot desert, grass land, tropical and temperate rainforest and *aquatic* includes ponds, river, streams, lakes, estuaries, oceans, mangroves, swamps and bays etc. However these two ecosystems are self regulating open system with a free exchange of inputs and outputs with other systems. Artificial ecosystems are simple, human-made, unstable and subjected to human intervention and manipulation. Usually it is formed by clearing a part of the forest or grassland e.g. crop field, agricultural land.

1.10.1 Structure and Function of an ecosystem

An ecosystem has two components the biotic components consisting of living things, and the abiotic portion, consisting of elements that are not alive. The non living constituents are said to include the following category, habitat, gases, solar radiation, temperature, moisture and inorganic and organic nutrients. The living organisms may be sub divided into producers, consumers and decomposers. Abiotic Components include basic inorganic and organic components of the environment or habitat of the organism. The inorganic components of an ecosystem are carbon dioxide, water nitrogen, calcium phosphate all of which are involved in matter cycle (biogeochemical cycles). The organic components of an ecosystem are proteins, carbohydrates, lipids and amino acids, all of which are synthesized by the biota (flora and fauna) of an ecosystem and are reached to ecosystem as their wastes, dead remains etc. the climate 'microclimate' temperature, light soil etc. are abiotic components of the ecosystems.



1.10.2 Functions of an Ecosytem

Ecosystem function is the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly. Ecosystem functions are subset of ecological processes and ecosystem structures. Each function is the result of the natural processes of the total ecological sub-system of which it is a part. Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy. There are four primary groups of ecosystem functions (1) regulatory functions, (2) habitat functions, (3) production functions and (4) information functions. This grouping concerns all ecosystems, not only for forests.

1.10.3 General characterization of ecosystem functions

(1) Regulatory functions: this group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through bio-geochemical cycles and other biospheric processes. In addition to maintaining the ecosystem (and biosphere health), these regulatory functions provide many services that have direct and indirect benefits to humans (i.e., clean air, water and soil, and biological control services).

(2) Habitat functions: natural ecosystems provide refuge and a reproduction habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and the evolutionary process.

(3) Production functions: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass. This broad diversity in carbohydrate structures provides many ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material.

(4) Information functions: Since most of human evolution took place within the context of an undomesticated habitat, natural ecosystems contribute to the maintenance of human health by

providing opportunities for reflection, spiritual enrichment, cognitive development, recreation and aesthetic experience.

Components of an ecosystem: Complete ecosystem consists of four basic components such as producers, consumers, decomposers and abiotic components e.g. Pond. If anyone of these four components are lacking, then it is grouped under incomplete ecosystem e.g. Ocean depth or a cave.

Productivity in the Environment: The productivity of an ecosystem is the rate at which solar energy is fixed by the vegetation of the ecosystem; it is further classified into primary productivity, secondary productivity and net productivity.

Primary productivity refers to the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producers; it is further distinguished as gross primary productivity (GPP) and net primary productivity (NPP). It is expressed in terms of weight ($g/m^2/yr$) or energy ($kcal/m^2$). Secondary productivity refers to the rates of energy storage at consumer levels.

An understanding of ecology is essential in the management of modern industrialized societies in ways that are compatible with environmental preservation and enhancement. The branch of ecology that deals with predicting the impacts of technology and development and making recommendations such that these activities will have minimum adverse impacts, or even positive impacts, on ecosystems may be termed as Applied Ecology. It is a multidisciplinary approach.

Interactions among living organisms are grouped into two major groups *viz*.

- Positive interactions
- Negative interactions

I. Positive interactions

Here the populations help one another, the interaction being either one way or reciprocal. These include (i) Commensalism, (ii) Proto co-operation and (iii) mutualism.

(i). Commensalism

In this one species derives the benefits while the other is unaffected.

Eg. (i) Cellulolytic fungi produce a number of organic acids from cellulose which serve as carbon sources for non-cellulolytic bacteria and fungi.

(ii) Growth factors are synthesised by certain microorganisms and their excretion permits the proliferation of nutritionally complex soil inhabitants.

(ii). Proto-cooperation

It is also called as non-obligatory mutualism. It is an association of mutual benefit to the two species but without the co-operation being obligatory for their existence or for their performance of reactions.

Eg. N_2 can be fixed by *Azotobacter* with cellulose as energy source provided that a cellulose decomposer is present to convert the cellulose to simple sugars or organic acids.

(iii). Mutualism

Mutually beneficial interspecific interactions are more common among organisms. Here both the species derive benefit. In such association there occurs a close and often permanent and obligatory contact more or less essential for survival of each.

Eg. (i) Pollination by animals. Bees, moths, butterflies etc. derive food from hectar, or other plant product and in turn bring about pollination.

(ii) Symbiotic nitrogen fixation:

Legume - *Rhizobium* symbiosis. Bacteria obtain food from legume and in turn fix gaseous nitrogen, making it available to plant.

II. Negative interactions

Member of one population may eat members of the other population, compete for foods, excrete harmful wastes or otherwise interfere with the other population. It includes (i) Competition, (ii) Predation, (iii) Parasitism and (iv) Antibiosis.

(i) Competition

It is a condition in which there is a suppression of one organism as the two species struggle for limiting quantities of nutrients O_2 space or other requirements.

Eg. Competition between *Fusarium oxysporum* and *Agrobacterium radiobacter*.

(ii) Predation

A predator is free living which catches and kills another species for food. Most of the predatory organisms are animals but there are some plants (carnivorous) also, especially fungi, which feed upon other animals.

Eg. (i) Grazing and browsing by animals on plants.

(ii) Carnivorous plants such as *Nepenthes, Darligtoria, Drosera* etc. consume insects and other small animals for food.

(iii)Protozoans feeding on bacteria.

(iii) Parasitism

A parasite is the organism living on or in the body of another organism and deriving its food more or less permanently from its tissues. A typical parasite lives in its host without killing it, whereas the predator kills it's upon which it feeds.

g. Species of *Cuscuta* (total stem parasite) grow on other plants on which they depend for nourishment.

Parasitism may occur even with in the species. Hyperparasites are chiefly fungi growing parasitically on other parasites, (i.e.,) Parasite on a parasite.

Eg. *Cicinnobolus cesatii* is found as hyperparasite on a number of powdery mildew fungi.

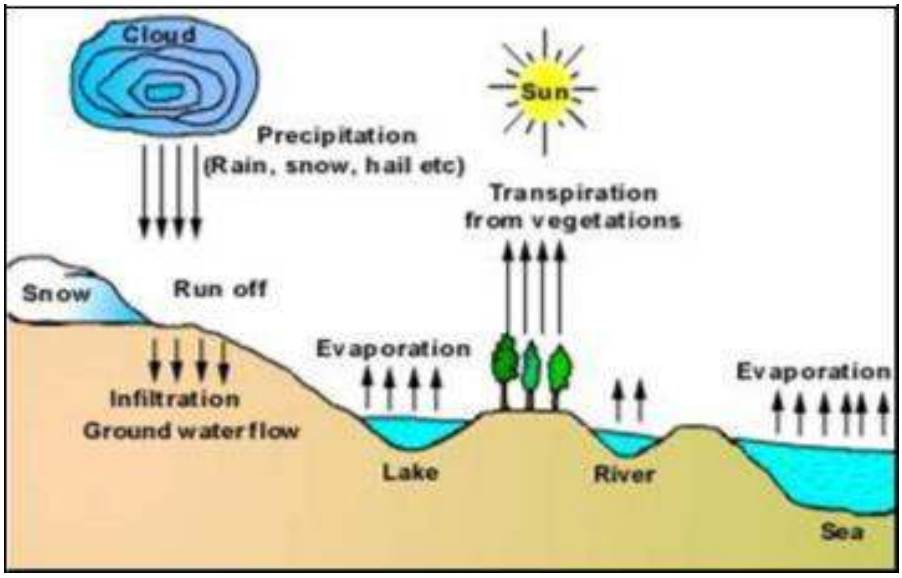
(iv) Antibiosis

The phenomenon of the production of antibiotic is called as antibiosis. Antibiotic is an organic substance produced by one organism which in low concentration inhibits the growth of other organism.

Eg. Streptomycin - *S.griseus* , Penicillin - P. *notatum* , *Trichoderma harzianum* inhibits the growth of *Rhizoctonia* sp.

1.11 MATTER AND CYCLES OF MATTER

Biogeochemical cycles describe the circulation of matter, particularly plant and animal nutrients, through ecosystems. These cycles are ultimately powered by solar energy, fine-tuned and directed by energy expended by organisms. In a sense, the solar-energy-powered hydrologic cycle acts as an endless conveyer belt to move materials essential for life through ecosystems.

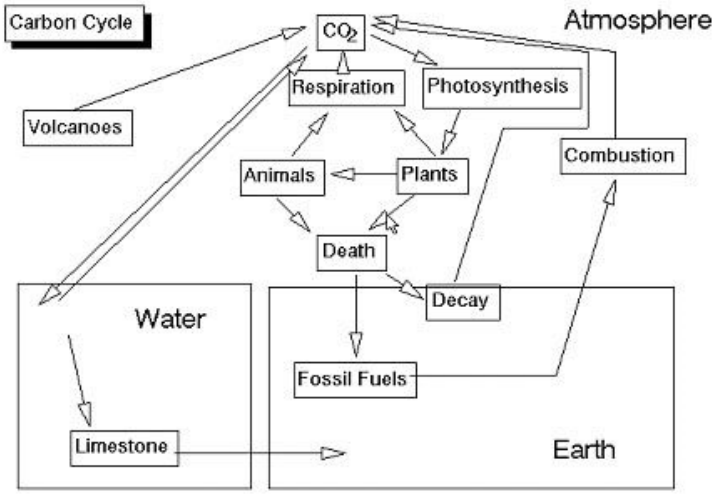


Most biogeochemical cycles can be described as elemental cycles involving nutrient elements such as carbon, oxygen, nitrogen, sulfur and phosphorus. Many are gaseous cycles in which the element in question spends part of the cycle in the atmosphere – O_2 for oxygen, N_2 for nitrogen, CO_2 for carbon. Others, notably the phosphorus cycle, do not have a gaseous component and are called sedimentary cycles. All sedimentary cycles involve salt solutions or soil solutions that contain dissolved substances leached from weathered minerals that may be deposited as mineral formations or they may be taken up by organisms as nutrients. The sulfur cycle, which may have H_2S or SO_2 in the gaseous phase or minerals ($CaSO_4$ $2H_2O$) in the solid phase, is a combination of gaseous and sedimentary cycles.

1.11.1 Carbon Cycle

Carbon, the basic building block of life molecules, is circulated through the carbon cycle. This cycle shows that carbon may be present as gaseous atmospheric CO_2, dissolved in groundwater as HCO_3 or molecular CO_2 (aq), in underlying rock strata as limestone ($CaCO_3$), and as organic matter, represented in a simplified manner as (CH_2O). Photosynthesis fixes inorganic carbon as biological carbon, which is a constituent of all life molecules.

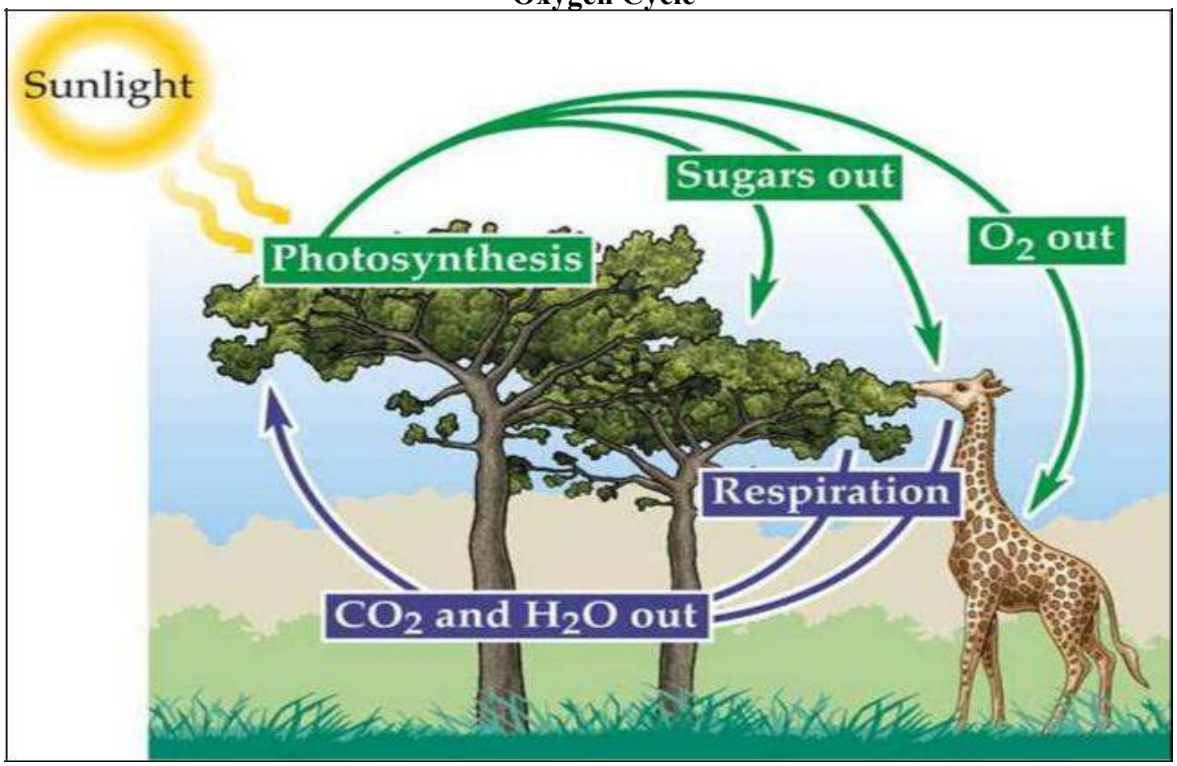
An important aspect of the carbon cycle is that it is the cycle by which energy is transferred to biological systems. Organic or biological carbon, (CH_2O), is an energy-rich molecule that can react biochemically with molecular oxygen, O_2, to regenerate carbon dioxide and produce energy. This can occur in an organism as shown by the "decay" reaction or it may take place as combustion, such as when wood is burned.



1.11.2 Oxygen Cycle

The oxygen cycle involves the interchange of oxygen between the elemental form of gaseous O_2 in the atmosphere and chemically bound O in CO_2, H_2O, and organic matter. Elemental oxygen becomes chemically bound by various energy-yielding processes, particularly combustion and metabolic processes in organisms. It is released during photosynthesis.

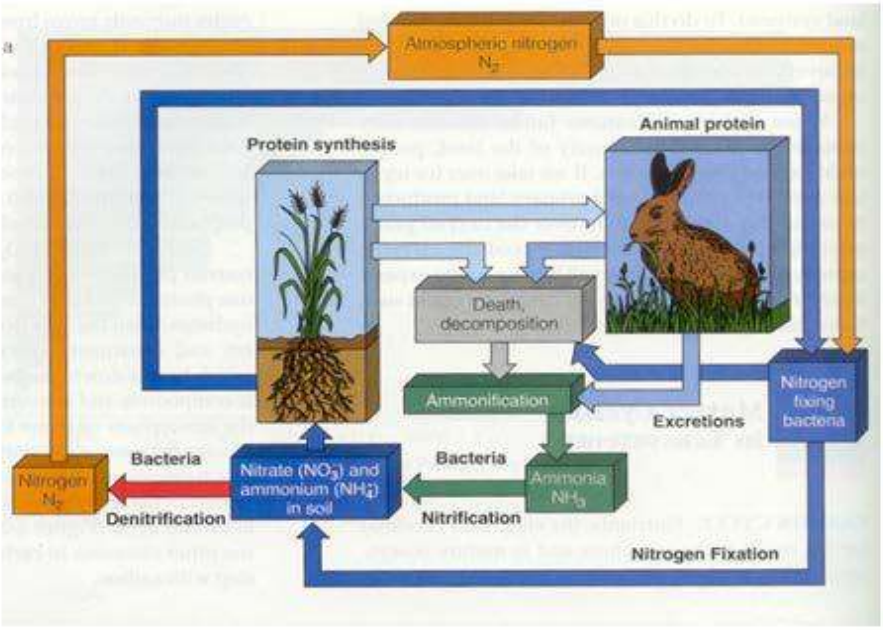
Oxygen Cycle



1.11.3 Nitrogen Cycle

Nitrogen, though constituting much less of biomass than carbon or oxygen, is an essential constituent of proteins. The atmosphere is 78% by volume elemental nitrogen, N_2 and constitutes an inexhaustible reservoir of this essential element. The N_2 molecule is very stable so that breaking it down to atoms that can be incorporated in inorganic and organic chemical forms of nitrogen is the limiting step in the nitrogen cycle. This does occur by highly energetic processes in lightning discharges such that nitrogen becomes chemically combined with hydrogen or oxygen as ammonia or nitrogen oxides. Elemental nitrogen is also incorporated into chemically bound forms or fixed by biochemical processes mediated by microorganisms. The biological nitrogen is returned to the inorganic form during the decay of biomass by a process called mineralization.

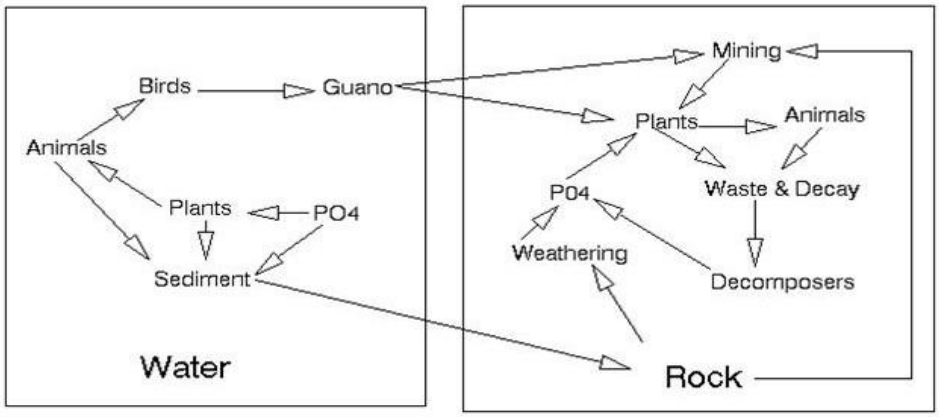
Nitrogen Cycle



1.11.4 Phosphorus cycle

The phosphorus cycle is crucial because phosphorus is usually the limiting nutrient in ecosystems. There are no common stable gaseous forms of phosphorus, so the phosphorus cycle is strictly sedimentary. In the geosphere phosphorus is held largely in poorly soluble minerals, such as hydroxyapatite, a calcium salt. Soluble phosphorus from these minerals and other sources, such as fertilizers, is taken up by plants and incorporated into the nucleic acids of biomass. Mineralization of biomass by microbial decay returns phosphorus to the salt solution from which it may precipitate as mineral matter.

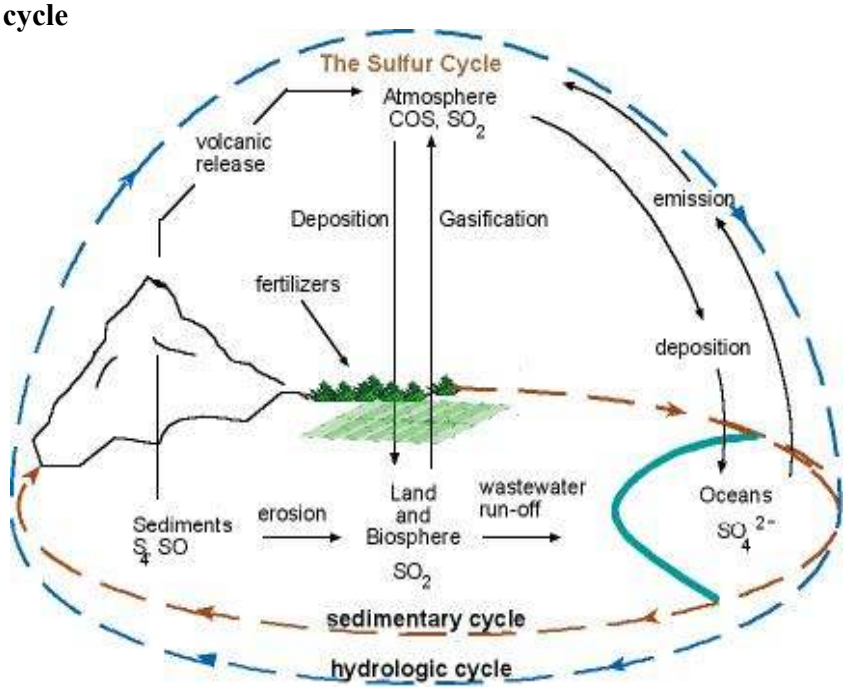
Phosphorus cycle



1.11.5 Sulfur cycle

The sulfur cycle is relatively complex. It involves several gaseous species, poorly soluble minerals, and several species in solution. It is involved with the oxygen cycle in that sulfur combines with oxygen to form gaseous sulfur di oxide (SO_2) an atmospheric pollutant, and soluble sulfate ion, (SO_4^{2-}). Among the significant species involved in the sulfur cycle are gaseous hydrogen sulfide, H_2S; mineral sulfides, such as PbS; sulfuric acid, H_2SO_4, the main constituent of acid rain; and biologically bound sulfur in sulfur-containing proteins.

Sulfur cycle



It should be obvious that material cycles, often based on elemental cycles, are very important in the environment.

1.11.6 Energy and cycles of energy

Biogeochemical cycles and virtually all other processes on Earth are drive by energy from the sun. The sun acts as a blackbody radiator with an effective surface temperature of 5780 K (Celsius degrees above absolute zero). It transmits energy to earth as electromagnetic radiation. The maximum energy flux of the incoming solar energy is at a wavelength of about

500 nanometers, which is in the visible region of the spectrum. A 1 square meter area perpendicular to the line of solar flux at the top of the atmosphere receives energy at a rate of 1,340 watts, sufficient, for example, to power an electric iron. This is called solar flux.

Energy in natural systems is transferred by heat, which is the form of energy that flows between two bodies as a result of their difference in temperature, or by work, which is transfer of energy that does not depend upon a temperature difference, as governed by the laws of thermodynamics. The first law of thermodynamics states that, although energy may be transferred or transformed, it is conserved and is not lost. Chemical energy in the food ingested by organisms is converted by metabolic processes to work or heat that can be utilized by the organisms, but there is no net gain or loss of energy overall. The second law of thermodynamics describes the tendency toward disorder in natural systems. It demonstrates that each time, energy is transformed; some is lost in the sense that it cannot be utilized for work, so only a fraction of the energy that organisms derive from metabolizing food can be converted to work; the rest is dissipated as heat.

1.11.7 Energy Flow

Energy is the capacity to do work. Solar energy is transformed into chemical energy by the process of photosynthesis, and is stored in plant tissue and then transformed into mechanical and heat forms during metabolic activities.

The energy, in the biological world, flows from the sun to plants and then to all heterotrophic organisms such as microorganisms, animals and man. Energy flow is the key function in an ecosystem and it is unidirectional.

'The study of energy transfer at different tropic level is known as 'Bioenergetics'

Energy Flow and Photosynthesis

Whereas materials are recycled through ecosystems, the flow of useful energy may be viewed as essentially a one-way process. Incoming solar energy can be regarded as high-grade energy because it can cause useful reactions to occur, the most important of which in living systems is photosynthesis. Solar energy captured by green plants energizes chlorophyll, which in

turn powers metabolic processes that produce carbohydrates from water and carbon dioxide. These carbohydrates represent stored chemical energy that can be converted to heat and work by metabolic reactions with oxygen in organisms. Ultimately, most of the energy is converted to low-grade heat, which is eventually re-radiated away from Earth by infrared radiation.

Check your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of the unit

v) The study of energy transfer at different trophic level is known as ----------

vi) The volume of nitrogen in the atmosphere is ----------

vii) The phenomenon of the production of antibiotic is called as ----------

viii) There are ---------- primary groups of ecosystem functions

1.12 LET US SUM UP

In this unit you have studied in detail about the basic concepts, definitions, meaning, needs and objectives of environmental education. You have learned about the strategies for environmental education and awareness. Moreover you have identified the major constraints for the implementation of environmental education at school level. You have understood the concepts of eco-systems and the energy conservation cycles.

1.13 EVALUATION

1. Define the term environment.
2. Explain the rationale for environmental education.
3. List out the major constraints for the implementation of environmental education at school level.
4. Explain the concept of eco-systems.
5. Explain the Carbon cycle.
6. Explain the Oxygen cycle.
7. Explain the Nitrogen cycle.
8. Explain the Phosphorus cycle.

9. Explain the Sulfur cycle.

UNIT - END ACTIVITIES

- List out the co-curricular activities for environmental education
- Identify the suitable areas in your subject to integrate the concept of environmental education by which you are developing environmental awareness among the learners.

POINTS FOR DISCUSSION

"Knowledge about environment is not an end, but rather a beginning" – Discuss.

ANSWER TO CHECK YOUR PROGRESS

i)	Surrounding	ii)	Any two constraints
ii)	Atmosphere	iv)	d
iii)	Bioenergetics	vi)	78%
iv)	Antibiosis	viii)	Four

SUGGESTED READINGS

Nagarajan.K and Sivakumar.P, "Environmental Education", Ram Pub., Chennai – 93. (2003)

Pannerselvam, A and Mohana Ramakrishnan "Environmental science education" Sterling publication, New Delhi. (2005).

ENVIRONMENTAL PROBLEMS AND PROTECTION

UNIT – II

STRUCTURE

2.1 INTRODUCTION

All of the organic and inorganic components surrounding us, as well as the events, conditions and processes of their interactions are known as environment. Any undesirable change in the environment is known as environmental pollution. A pollutant is a containment that adversely alters the physical, chemical or biological properties of the environment. Literally, pollution means – to make or render unclear. Odum(1971) defines, 'pollution is an undesirable change in the physical, chemical or biological characteristics of our land, air, or water what may or will harmfully affect human life or that of desirable species.

2.2 OBJECTIVES

At the end of the unit, you will be able to

- Define the term pollution
- Identify the major pollutants which are responsible for the environmental pollution
- Describe the nature and causes of air, water, noise, radiation pollution
- Appreciate the nature of the clear environment
- Identify the appropriate steps to curb the evil of pollution
- Recognize the way of protecting and management of environment
- Choose the appropriate and effective strategies to preserve and restore the environment
- Explain the extension of flora and fauna
- Analyze the various causes for deforestation and soil erosion
- Realize the importance of environmental protection

2.3 INTRODUCTION OF ENVIRONMENTAL POLLUTION

We know that, a living organism cannot live by itself. Organisms interact among themselves. Hence, all organisms, such as plants, animals and human beings, as well as the physical surroundings with whom we interact, form a part of our environment. All these constituents of the environment are dependent upon each other. Thus, they maintain a balance in nature. As we are the only organisms try to modify the environment to fulfill our needs; it is our responsibility to take necessary steps to control the environmental imbalances.

The environmental imbalance gives rise to various environmental problems. Some of the environmental problems are pollution, soil erosion leading to floods, salt deserts and sea recedes, desertification, landslides, change of river directions, extinction of species, and vulnerable ecosystem in place of more complex and stable ecosystems, depletion of natural resources, waste accumulation, deforestation, thinning of ozone layer and global warming. The environmental problems are visualized in terms of pollution, growth in population, development, industrialization, unplanned urbanization etc. Rapid migration and increase in population in the urban areas has also lead to traffic congestion, water shortages, solid waste, and air, water and noise pollution are common noticeable problems in almost all the urban areas since last few years.

2.3.1 Definition of Environmental Pollution

Environmental pollution is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water. As a result of over-population, rapid industrializations, and other human activities like agriculture and deforestation etc., earth became loaded with diverse pollutants that were released as by-products.

Pollutants are generally grouped under two classes:

(a) Biodegradable pollutants – Biodegradable pollutants are broken down by the activity of micro-organisms and enter into the biogeochemical cycles. Examples of such pollutants are domestic waste products, urine and faucal matter, sewage, agricultural residue, paper, wood and cloth etc.

(b) Non- Biodegradable pollutants – Non-biodegradable pollutants are stronger chemical bondage, do not break down into simpler and harmless products. These include various insecticides and other pesticides, mercury, lead, arsenic, aluminum, plastics, radioactive waste etc.

2.3.2 Classification of Environmental Pollution

Pollution can be broadly classified according to the components of environment that are polluted. Major of these are: Air pollution, Water pollution, Soil pollution (land degradation) and Noise pollution. Details of these types of pollutions are discussed below with their prevention measures.

(i) Air Pollution:

Air is mainly a mixture of various gases such as oxygen, carbon dioxide, nitrogen. These are present in a particular ratio. Whenever there is any imbalance in the ratio of these gases, air pollution is caused. The sources of air pollution can be grouped as under

(i) **Natural**: such as, forest fires, ash from smoking volcanoes, dust storm and decay of organic matters.

(ii)**Man-made:** due to population explosion, deforestation, urbanization and industrializations.

Certain activities of human beings release several pollutants in air, such as carbon monoxide (CO), sulfur dioxide (SO_2), hydrocarbons (HC), oxides of nitrogen (NOx), lead, arsenic, asbestos, radioactive matter, and dust. The major threat comes from burning of fossil fuels, such as coal and petroleum products. Thermal power plants, automobiles and industries are major sources of air pollution as well. Due to progress in atomic energy sector, there has been an increase in radioactivity in the atmosphere. Mining activity adds to air pollution in the form of particulate matter. Progress in agriculture due to use of fertilizers and pesticides has also contributed towards air pollution. Indiscriminate cutting of trees and clearing of forests has led to increase in the amount of carbon dioxide in atmosphere.

Global warming is a consequence of green house effect caused by increased level of carbon dioxide (CO_2). Ozone (O3) depletion has resulted in UV radiation striking our earth.

The gaseous composition of unpolluted air	
The Gases	**Parts per million (vol)**
Nitrogen	756,500
Oxygen	202,900
Water	31,200
Argon	9,000
Carbon Dioxide	305
Neon	17.4
Helium	5.0
Methane	0.97-1.16
Krypton	0.97
Nitrous oxide	0.49
Hydrogen	0.49
Xenon	0.08
Organic vapours	ca.0.02

Global warming is a consequence of green house effect caused by increased level of carbon dioxide (CO_2). Ozone (O3) depletion has resulted in UV radiation striking our earth.

Industrial / Vehicular pollution

The coolest culprits of environmental degradation in metropolitan cities are vehicular and industrial pollution. Since 1975 the Indian economy has grown 2.5 times, the industrial pollution load has grown 3.47 times and the vehicular pollution load 7.5 times, in Delhi, for example 70% of air pollution is caused by vehicular pollution. Thanks to the 3 million vehicles on its roads- while industries account for 17%. The pollutants emitted by the vehicles could produce inflammatory effects on the respiratory organs, could be toxic or even carcinogenic depending upon the fuel type, In India, vehicles primarily run on diesel or petrol.

Harmful Effects of air pollution

(a) It affects respiratory system of living organisms and causes bronchitis, asthma, lung cancer, pneumonia etc. Carbon monoxide (CO) emitted from motor vehicles and cigarette smoke affects the central nervous system.

(b) Due to depletion of ozone layer, UV radiation reaches the earth. UV radiation causes skin cancer, damage to eyes and immune system.

(c) Acid rain is also a result of air pollution. This is caused by presence of oxides of nitrogen and sulfur in the air. These oxides dissolve in rain water to form nitric acid and sulfuric acid respectively. Various monuments, buildings, and statues are damaged due to corrosion by acid present in the rain. The soil also becomes acidic. The cumulative effect is the gradual degradation of soil and a decline in forest and agricultural productivity.

(d) The green house gases, such as carbon dioxide (CO2) and methane (CH4) trap the heat radiated from earth. This leads to an increase in earth's temperature.

(e) Some toxic metals and pesticides also cause air pollution.

(ii) Water Pollution

Water is one of the prime necessities of life. With increasing number of people depend on this resource; water has become a scarce commodity. Pollution makes even the limited available water unfit for use. Water is said to be polluted when there is any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for use. Sources of water pollution are mainly factories, power plants, coal mines and oil wells situated either close to water source or away from sources. They discharge pollutants directly or indirectly into the water sources like river, lakes, water streams etc. The water pollution have the following harmful effects.

(a) Human beings become victims of various water borne diseases, such as typhoid, cholera, dysentery, hepatitis, jaundice, etc.

(b) The presence of acids/alkalies in water destroys the microorganisms, thereby hindering the self-purification process in the rivers or water bodies. Agriculture is affected badly due to polluted water. Marine eco-systems are affected adversely.

(c) The sewage waste promotes growth of phytoplankton in water bodies; causing reduction of dissolved oxygen.

(d) Poisonous industrial wastes present in water bodies affect the fish population and deprives us of one of our sources of food. It also kills other animals living in fresh water.

(e) The quality of underground water is also affected due to toxicity and pollutant content of surface water.

India has 12 major rivers with a total catchments area of 252.8 million hectare. The Indian homes produce about 75 % of the wastewater, and sewage treatment facilities are inadequate in most cities and almost absent in rural India. According to the Central pollution Control Board, of the 8,432 large and medium industries in the country, only 4,989 had installed appropriate measures to treat wastewater before discharge. Of the over two million small scale industrial units, a number of which like tanneries are extremely polluting, very few have any treatment facilities whatsoever and their untreated wastes invariably find their way into country's water systems.

Water pollution by industries and its effects

A change in the chemical, physical, biological, and radiological quality of water that is injurious to its uses. The term "water pollution" generally refers to human-induced changes to water quality. Thus, the discharge of toxic chemicals from industries or the release of human or livestock waste into a nearby water body is considered pollution.

The contamination of ground water of water bodies like rivers, lakes, wetlands, estuaries, and oceans can threaten the health of humans and aquatic life. Sources of water pollution may be divided into two categories.

(i) Point-source pollution, in which contaminants are discharged from a discrete location. Sewage outfalls and oil spills are examples of point-source pollution.

(ii) Non-point-source or diffuse pollution, referring to all of the other discharges that deliver contaminants to water bodies. Acid rain and unconfined runoff from agricultural or urban areas falls under this category.

The principal contaminants of water include toxic chemicals, nutrients, biodegradable organics, and bacterial & viral pathogens. Water pollution can affect human health when pollutants enter the body either via skin exposure or through the direct consumption of contaminated drinking water and contaminated food. Prime pollutants, including DDT and polychlorinated biphenyls (PCBs), persist in the natural environment and bioaccumulation occurs in the tissues of aquatic organisms. These prolonged and persistent organic pollutants are transferred up the food chain and they can reach levels of concern in fish species that are eaten by humans. Moreover, bacterial and viral pathogens can pose a public health risk for those who drink contaminated water or eat raw shellfish from polluted water bodies.

Contaminants have a significant impact on aquatic ecosystems. Enrichment of water bodies with nutrients (principally nitrogen and phosphorus) can result in the growth of algae and other aquatic plants that shade or clog streams. If wastewater containing biodegradable organic matter is discharged into a stream with inadequate dissolved oxygen, the water downstream of the point of discharge will become anaerobic and will be turbid and dark. Settle able solids will be deposited on the streambed, and anaerobic decomposition will occur. Over the reach of stream where the dissolved-oxygen concentration is zero, a zone of putrefaction will occur with the production of hydrogen sulfide (H_2S), ammonia (NH_3), and other odorous gases. Because many fish species require a minimum of 4–5 mg of dissolved oxygen per liter of water, they will be unable to survive in this portion of the stream.

Direct exposures to toxic chemicals are also a health concern for individual aquatic plants and animals. Chemicals such as pesticides are frequently transported to lakes and rivers via runoff, and they can have harmful effects on aquatic life. Toxic chemicals have been shown to reduce the growth, survival, reproductive output, and disease resistance of exposed organisms.

These effects can have important consequences for the viability of aquatic populations and communities.

Wastewater discharges are most commonly controlled through effluent standards and discharge permits. Under this system, discharge permits are issued with limits on the quantity and quality of effluents. Water-quality standards are sets of qualitative and quantitative criteria designed to maintain or enhance the quality of receiving waters. Criteria can be developed and implemented to protect aquatic life against acute and chronic effects and to safeguard humans against deleterious health effects, including cancer.

(iii) Soil pollution (Land degradation)

Land pollution is due to

(i) Deforestation and

(ii) Dumping of solid wastes.

Deforestation increases soil erosion; thus valuable agricultural land is lost. Solid wastes from household and industries also pollute land and enhance land degradation. Solid wastes include things from household waste and of industrial wastes. They include ash, glass, peelings of fruit and vegetables, paper, clothes, plastics, rubber, leather, brick, sand, metal, waste from cattle shed, night soil and cow dung. Chemicals discharged into air, such as compounds of sulfur and lead, eventually come to soil and pollute it. The heaps of solid waste destroy the natural beauty and surroundings become dirty. Pigs, dogs, rats, flies, mosquitoes visit the dumped waste and foul smell comes from the waste. The waste may block the flow of water in the drain, which then becomes the breeding place for mosquitoes. Mosquitoes are carriers of parasites of malaria and dengue. Consumption of polluted water causes many diseases, such as cholera, diarrhea and dysentery.

(iv) Poisoned by Pesticides

Poisoning from pesticides affects 68,000 farmers and workers every day; annually, an estimated 25 million workers suffer from pesticide poisoning throughout the world. Farmers and

agricultural workers are exposed to pesticides directly when they are mixing and spraying these pesticides, especially so in developing countries such as Asia. Every year, about 3 million people are poisoned around the world and 200,000 die from pesticide use.

Beyond these reported acute cases of pesticide poisoning, evermore worrying are the chronic long-term effects such as cancers, adverse effects-not only on specific body organs and systems but also on the endocrine system which include reduction in male sperms count and undecided testes as well as increasing incidences of breast cancer. Communities and Consumers are insidiously exposed to pesticides through contamination of the soil, air and water. The chronic effects of pesticides are particularly alarming when new studies link certain pesticides to cancer, lowered fertility and disruption of the endocrine system and to the suppression of immune systems.

Farming and Agricultural Worker communities in Warangal, Andhra Pradesh, who have been poisoned by Pesticides during spraying, Warangal is already in famous for the large number of cotton farmer suicide deaths, one the main reasons during the farmers to suicide in the resistance being developed by pests to pesticides. Pesticides Action Network Asia and the Pacific (PANAD) first launched 'No Pesticide Use Day' in 1998 to protest the manufacture and use of pesticides worldwide. The day is held to commemorate the thousand who dies, and the tens of thousands who still suffer and continue to dies, as a result of the 1984 Bhopal Disaster. The tragedy of Bhopal is a powerful and poignant example of chemical pesticide contamination; the victims continue to suffer to this day.

(v) Pesticides in Soft Drinks

Soft drinks are non-alcoholic water-based flavored drinks that are optionally sweetened, acidulated and carbonated. Some carbonated soft drinks also contain caffeine; mainly the brown colored cola drinks. The two global majors PepsiCo and Coca-Cola dominate the soft drink market in India.

Coco-Cola brands -Thumps Up, Limca, sprite, minute made, and Gold Spot from Parle Beverages and soft drink brands Crush, Canada Dry and Sport Cola from Cadbury.

PepsiCo brands - Pepsi-Cola Brands, Frito-Lay Brands, Tropicana Brands, Quaker Brands, and Gatorade Brands.

Sample Analysis

A laboratory report prepared by CSE in 2003 detailed some astonishing facts about the extent of pesticide contamination in soft drinks sold in India. CSE found high levels of toxic pesticides and insecticides, high enough to cause cancer, damage to the nervous and reproductive systems, birth defects and severe disruption of the immune system. Market leaders Coca-Cola and Pepsi had almost similar concentrations of pesticide residues. At the same time CSE also tested two soft drink brands sold in the US, to see if they contained pesticides. They didn't. This only goes to show the companies were following dual standards.

- Among the total pesticide found in 18 cities in India, Kolkata is on the top and Guwahati is in the bottom of that list. Kolkata has pesticide content in cold drinks of about 51.7 ppb. The pesticides cause irreparable harm to the human body.
- It has been shown time and again that these pesticides can be used to kill bacteria in bathrooms. The acidic content of these drinks are harmful to the human body.

2.3.3 Hazardous Waste

Hazardous waste may be liquid, solid or gas and all have one thing in common are dangerous and can pose a substantial hazard to human health and environment when not managed properly. In India, generation of hazardous waste to the tune of 6-7 million tonnes per year and may vary depending on the nature and quantity of hazardous waste generated in India. The major hazardous waste in India is petrochemicals, pharmaceuticals, pesticides, paints, dyes, fertilizers and other different industries

(i) Release of Hazardous waste from industries

The lack of a preventive approach to waste management has led to generation of more and more hazardous wastes and sadly, controlling hazardous waste has become a serious problem in India and no special care is taken in their management. Implementation of the ban on the ground is very negligent and hazardous waste is coming to our shores in regular phenomenon. Apart-from generating their own hazardous wastes, India invites import to such

waste in the name of reuse and recycling, though there is lack of environmental friendly technology to reuse and recycle hazardous waste.

Thus indiscriminate generations, improper handling, storage and disposal of hazardous waste are the main factors contributing to the environmental and human health impact. The pressing need is to rethink the present approach of pollution control and end-of-the-pipe approaches and focus on pollution prevention, waste minimization, cleaner production and toxics reduction.

(ii) Biomedical Waste

Biomedical waste includes both organic and inorganic wastes generated from hospitals. On an average a hospital bed generates 1 kg of waste per day, out of which 10-15% is infectious, 5% is hazardous and rest us general waste. Every day, country's numerous hospitals and medical facilities churn out tones of waste. A WHO report documents that Hepatitis – B Virus can survive in a spring for 8 days.

The disposable syringe one uses with a sense of security may actually be giving a false sense of security. It may actually be a used syringe repacked by the mafia, which is involved in medical waste trafficking. Unmediated and unhealed syringe in the municipal dump may come back in the hospitals and may then be used on a patient, who may get cross-infected.

The problem of Medical waste has acquired gargantuan proportions and complex dimensions. While the health care establishments are trying to provide better medicare facility of the citizens, the hospital waste disposal systems are undermining such efforts. The rules for management of this waste exist, what is urgently needed now is training of all the health care staff and setting up waste management system in the hospitals.

Plastics constitute a major chunk of medical waste. In fact, in India, the market for medical disposable has grown from US$2.350 million (1979) to 4,000 million (1986). The use of plastics in medical equipment is now growing at the rate of 6% per annum. Even though plastics reduce the possibility of transmission of infection with in the hospital, there are many problems related to its use and disposal.

(iii) Mercury is more poisonous and Dangerous than Lead and Arsenic.

Cracking down on crackers Over the years, Diwali has turned into a festival of pollution by noise, crackers, artificially coloured sweets and serious health hazards. On this day, cities turn into gas chambers increases toxic fumes and gases like CO_2, SO_2, NO_2, as well as suspended particulate matter (SPM), in the air. The worst affected are children, Pregnant women and those suffering from respiratory problems. In addition, the factories making crackers float safety norms and exploit child labour. These children work for 16-18 hrs each day in unhygienic dingy, make-shift and suffocating factories-for only Rs.10-15 per day. They handle chemical that cause deadly diseases of the lungs, kidneys, skin and eyes.

2.3.4 E- Waste

• People discard computers every two to four years on average.

• Cell phones have a life-cycle of less than two years in industrialized countries.

• Each computer screen contains about 20% lead by weight.

• A mobile phone, is 19 % copper and 8% iron.

• Informal name for electronic products nearing end of their “useful life”.

• Large household appliances - Refrigerators Air conditioners, computers & Stereo systems, Mobile phones.

• Its volume increases by 3-5% per annum.

• Major pollutants are Heavy metals – Hg, Pb, Cd, Cr (VI) and Flame retardants – Polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDEs).

International Scenario

• 20-50 MT / yr of e waste are generated world-wide.

• USA accounts 1% to 3% of the total municipal waste generation.

• EU - 5 to 7 million tonnes per annum or about 14 to 15 kg per capita and is expected to grow at a rate of 3% to 5% per year.

• In developed countries, currently it equals 1% of total solid waste generation and is expected to grow to 2% by 2010.

Magnitude of the problem in India

• India – 1,46,000 tonnes to 4.7 lakh tonnes by 2011.

• India's e-waste generation is growing at the rate of 15per cent and is expected to cross 800,000 tonne by 2012.

• Sixty-five cities generate more than 60% of the total e-waste in India.

• Top cities (70%) – Mumbai, Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

• 50,000 MT / yr illegally imported.

2.3.5 Nuclear Pollution

Radioactive substances when released into the environment are either dispersed or become concentrated in living organisms through the food chain. Other than naturally occurring radioisotopes, significant amounts are generated by human activity, including the operation of nuclear power plants, the manufacture of nuclear weapons, and atomic bomb testing.

For example, strontium 90 behaves like calcium and is easily deposited and replaces calcium in the bone tissues. It could be passed to human beings through ingestion of strontium-contaminated milk. Again another example is tritium, which is radioactive hydrogen.

The amount of tritium released from nuclear power plants to the atmosphere have reached as high as tens of thousands of curies in one year, and releases to bodies of water have measured as high as tens of millions of picocuries per litre. The U.S. Environmental Protection Agency standard for permissible levels of tritium in drinking water is 20,000 picocuries per litre.

Nuclear power plants routinely and accidentally release tritium into the air and water. Tritium has a half-life of 12.3 years and emits radioactive beta particles. Once tritium is inhaled or swallowed, its beta particles can bombard cells causing a mutation.

Few occupations that involve radioactive exposures are uranium mineworkers, radium watch dial painters, technical staff at nuclear power plants, etc. Exposure to radioactive and nuclear hazards has been clinically proven to cause cancer, mutations and teratogenesis (Teratogenesis is a prenatal toxicity characterized by structural or functional defects in the developing embryo or fetus).

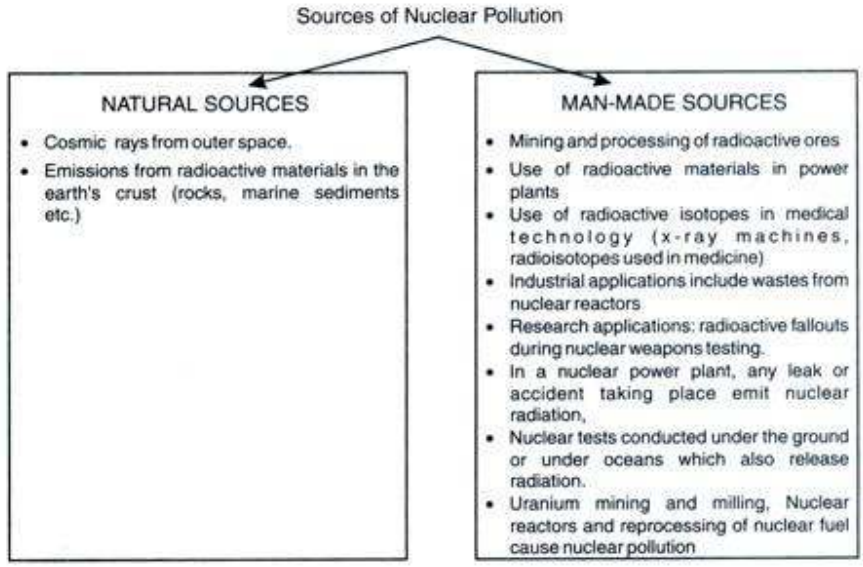
Nuclear hazard effects can be either initial or residual. Initial effects occur in the immediate area of explosion and are hazardous immediately after the explosion where as the residual effects can last for days or years and cause death. The principal initial effects are blast and radiation.

Blast causes damage to lungs, ruptures eardrums, collapses structures and causes immediate death or injury. Thermal Radiation is the heat and light radiation, which a nuclear explosion's fireball emits producing extensive fires, skin burns, and flash blindness. Nuclear radiation consists of intense gamma rays and neutrons produced during the first minute after the explosion.

This radiation causes extensive damage to cells throughout the body. Radiation damage may cause headaches, nausea, vomiting, diarrhea, and even death, depending on the radiation dose received.

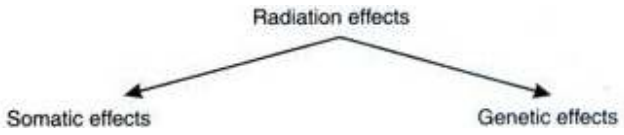
Sources of Nuclear Pollution

The sources of radioactivity include both natural and manmade.



Effects of Nuclear Pollution

Studies have shown that the health effects due to radiation are dependent on the level of dose, kind of radiation, duration of exposure and types of cells irradiated. Radiation effects can be somatic or genetic.



1. Somatic effects

Somatic effects the function of cells and organs. It causes damages to cell membranes, mitochondria and cell nuclei resulting in abnormal cell functions, cell division, growth and death.

2. Genetic effects

Genetic effects the future generations. Radiations can cause mutations, which are changes in genetic makeup of cells. These effects are mainly due to the damages to DNA molecules. People suffer from blood cancer and bone cancer if exposed to doses around 100 to 1000 roentgens. Instantaneous deaths may occur in the event of exposure.

Management of Radioactive Waste

a. The radioactive waste which comes out from industry, nuclear reactors should be stored and allowed to decay either naturally in closed drums or in very large underground air tight cemented tanks (Delay and Decay).

b. The intermediate radioactive waste should be disposed off into the environment after diluting it with some inert materials (Dilute and Disperse)

c. Now-a-days small quantities of high activity wastes are converted into solids such as concrete and then it is buried underground or sea. (Concentrate and contain)

Control Measures

a. Laboratory generated nuclear wastes should be disposed off safely and scientifically.

b. Nuclear power plants should be located in areas after careful study of the geology of the area, tectonic activity and meeting other established conditions.

c. Appropriate protection against occupational exposure.

d. Leakage of radioactive elements from nuclear reactors, careless use of radioactive elements as fuel and careless handling of radioactive isotopes must be prevented.

e. Safety measure against accidental release of radioactive elements must be ensured in nuclear plants.

f. Unless absolutely necessary, one should not frequently go for diagnosis by x-rays.

g. Regular monitoring of the presence of radioactive substance in high risk area should be ensured.

Among the many options for waste disposal, the scientists prefer to bury the waste in hundreds of meters deep in the earth’s crust is considered to be the best safety long term option.

2.3.6 Ozone Layer Depletion

Reduced ozone levels as a result of ozone depletion. A chemical destruction of the stratospheric ozone layer is beyond natural reactions. Stratospheric ozone is constantly being created and destroyed through natural cycles. Various ozone-depleting substances (ODS), however, accelerate the destruction processes, resulting in lower than normal ozone levels.

Effects on Human Health

Ozone layer depletion increases the amount of UVB that reaches the Earth's surface. Laboratory and epidemiological studies demonstrate that UVB causes non-melanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to the development of cataracts, a clouding of the eye's lens.

Effects on Plants

UVB radiation affects the physiological and developmental processes of plants. Despite mechanisms to reduce or repair these effects and an ability to adapt to increased levels of UVB, plant growth can be directly affected by UVB radiation.

Indirect changes caused by UVB may be equally or sometimes more important than damaging effects of UVB. These changes can have important implications for plant competitive balance, herbivores, plant diseases, and biogeochemical cycles.

Effects on Marine Ecosystems

UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians, and other marine animals. The most severe effects are decreased reproductive capacity and impaired larva development. Small increases in UVB exposure could result in population reductions for small marine organisms with implications for the whole marine food chain.

Effects on Biogeochemical Cycles

Increases in UVB radiation could affect terrestrial and aquatic biogeochemical cycles, thus altering both sources and sinks of greenhouse and chemically important trace gases (e.g., carbon dioxide, carbon monoxide, carbonyl sulfide, ozone, and possibly other gases). These potential changes would contribute to biosphere-atmosphere feedbacks that mitigate or amplify the atmospheric concentrations of these gases.

Effects on Materials

Synthetic polymers, naturally occurring biopolymers, as well as some other materials of commercial interest are adversely affected by UVB radiation. Today's materials are somewhat protected from UVB by special additives. Yet, increases in UVB levels will accelerate their breakdown, limiting the length of time for which they are useful outdoors.

2.4 IMPACTS OF URBANIZATION ON ENVIRONMENT

Urbanisation

Urbanization is a process that leads to the growth of cities due to industrialization and economic development, and that leads to urban- specific changes in specialization, labor division and human behaviors. The population is growing at the rate of about 17 million annually which means a staggering 45,000 births per day and 31 births per minutes. If the current trend continues, by the year 2050, India would have 1620 million populations. Due to uncontrolled urbanization in India, environmental degradation has been occurring very rapidly and causing many problems like shortages of housing, worsening water quality, excessive air pollution, noise, dust and heat, and the problems of disposal of solid wastes and hazardous wastes.

Probably most of the major environmental problems of the next century will result from the continuation and sharpening of existing problems that currently do not receive enough political attention. The problems are not necessarily noticed in many countries or then nothing is done even the situation has been detected. The most emerging issues are climate changes,

freshwater scarcity, deforestation, and fresh water pollution and population growth. These problems are very complex and their interactions are hard to define. It is very important to examine problems through the social-economic-cultural system. Even the interconnections between environmental problems are now better known, we still lack exact information on how the issues are linked, on what degree they interact and what are the most effective measures. One problem is to integrate land and water use planning to provide food and water security.

Impacts on the atmosphere and climate

1. The creation of heat island

Materials like concrete, asphalt, bricks etc absorb and reflect energy differently than vegetation and soil. Cities remain warm in the night when the countryside has already cooled.

2. Changes in Air Quality

Human activities release a wide range of emissions into the environment including carbon dioxide, carbon monoxide, ozone, sulfur oxides, nitrogen oxides, lead, and many other pollutants.

3. Changes in Patterns of Precipitation

Cities often receive more rain than the surrounding countryside since dust can provoke the condensation of water vapor into rain droplets.

Impacts on the lithosphere and land resources

1. **Erosion and other changes in land quality**

Rapid development can result in very high levels of erosion and sedimentation in river channels.

2. **Pollution**

Pollutants are often dispersed across cities or concentrated in industrial areas or waste sites. Lead- based paint used on roads and highways and on buildings is one such example of a

widely dispersed pollutant that found its way into soil. Burying tremendous amounts of waste in the ground at municipal and industrial dumps.

Impacts on the hydrosphere and water resources

1**. Flow of Water into Streams**

Natural vegetation and undisturbed soil are replaced with concrete, asphalt, brick, and other impermeable surfaces. This means that, when it rains, water is less likely to be absorbed into the ground and, instead, flows directly into river channels.

2. **Flow of Water through Streams**

Higher, faster peak flows change streams channels that have evolved over centuries under natural conditions. Flooding can be a major problem as cities grow and stream channels attempt to keep up with these changes.

3. **Degraded Water Quality**

The water quality has degraded with time due to urbanization that ultimately leads to increased sedimentation there by also increasing the pollutant in run-off.

Impacts on the biosphere

1. **Modification of Habitats**

The fertilizers that spread across lawns finds its way into water channels where it promotes the growth of plants at the expense of fish. The waste dumped into streams lowers oxygen levels during its decay and cause the die-off of plants and animals.

2. **Destruction of Habitats**

There is also complete eradication of habitats as an outcome of urbanization and native species are pushed out of cities.

3. **Creation of New Habitats**

New habitats are also created for some native and non-native species. Cities also create habitats for some species considered pests, such as pigeons, sparrows, rats, mice, flies and mosquitoes. Urbanization has, for example, eliminated many bat colonies in caves, but has provided sites such as bridges for these species to nest.

2.5 DEFORESTATION AND ITS IMPACT ON ENVIRONMENT

Deforestation is a contributor to global warming, and is often cited as one of the major causes of the enhanced greenhouse effect. Tropical deforestation is responsible for approximately 20% of world greenhouse gas emissions. Deforestation causes carbon dioxide to linger in the atmosphere. As carbon dioxide accrues, it produces a layer in the atmosphere that traps radiation from the sun. The radiation converts to heat which causes global warming, which is better known as the greenhouse effect.

Plants remove carbon in the form of carbon dioxide from the atmosphere during the process of photosynthesis. Only when actively growing can a tree or forest removes carbon, by storing it in plant tissues. Both the decay and burning of wood release much of this stored carbon back to the atmosphere. In order for forests to take up carbon, there must be a net accumulation of wood. Deforestation may also cause carbon stores held in soil to be released. Forests can be either sinks or sources depending upon environmental circumstances.

In deforested areas, the land heats up faster and reach a higher temperature, leading to localized upward motions that enhance the formation of clouds and ultimately produce more rainfall.

Rainforests are widely believed by laymen to contribute a significant amount of the world's oxygen, although it is now accepted by scientists that rainforests contribute little net oxygen to the atmosphere and deforestation has only a minor effect on atmospheric oxygen levels.

Hydrological

The water cycle is also affected by deforestation. Trees extract groundwater through their roots and release it into the atmosphere. When part of a forest is removed, the trees no longer transpire this water, resulting in a much drier climate. Deforestation reduces the content of water in the soil and groundwater as well as atmospheric moisture. The dry soil leads to lower water intake for the trees to extract. Deforestation reduces soil cohesion, so that erosion, flooding and landslides ensue.

As a result, the presence or absence of trees can change the quantity of water on the surface, in the soil or groundwater, or in the atmosphere. This in turn changes erosion rates and the availability of water for either ecosystem functions or human services. The forest may have little impact on flooding in the case of large rainfall events, which overwhelm the storage capacity of forest soil if the soils are at or close to saturation.

Soil

Undisturbed forests have a very low rate of soil loss. Deforestation generally increases rates of soil loss, by increasing the amount of runoff and reducing the protection of the soil from tree litter. This can be an advantage in excessively leached tropical rain forest soils. Forestry operations themselves also increase erosion through the development of roads and the use of mechanized equipment.

Tree roots bind soil together, and if the soil is sufficiently shallow they act to keep the soil in place by also binding with underlying bedrock. Tree removal on steep slopes with shallow soil thus increases the risk of landslides, which can threaten people living nearby.

Biodiversity

Deforestation on a human scale results in decline in biodiversity, and on a natural global scale is known to cause the extinction of many species. The removal or destruction of areas of forest cover has resulted in a degraded environment with reduced biodiversity. Forests support biodiversity, providing habitat for wildlife; moreover, forests foster medicinal conservation. With forest biotopes being irreplaceable source of new drugs (such as taxol), deforestation can destroy genetic variations (such as crop resistance) irretrievably.

Scientific understanding of the process of extinction is insufficient to accurately make predictions about the impact of deforestation on biodiversity. Most predictions of forestry related biodiversity loss are based on species-area models, with an underlying assumption that as the forest declines species diversity will decline similarly. However, many such models have been proven to be wrong and loss of habitat does not necessarily lead to large scale loss of species. Species-area models are known to over predict the number of species known to be

threatened in areas where actual deforestation is ongoing, and greatly over predict the number of threatened species that are widespread.

Economic impact

Damage to forests and other aspects of nature could halve living standards for the world's poor and reduce global GDP by about 7% by 2050, a report concluded at the Convention on Biological Diversity (CBD) meeting in Bonn. Historically, utilization of forest products, including timber and fuel wood, has played a key role in human societies, comparable to the roles of water and cultivable land. Today, developed countries continue to utilize timber for building houses, and wood pulp for paper. In developing countries almost three billion people rely on wood for heating and cooking.

Rapidly growing economies also have an effect on deforestation. Most pressure will come from the world's developing countries, which have the fastest-growing populations and most rapid economic (industrial) growth. In 1995, economic growth in developing countries reached nearly 6%, compared with the 2% growth rate for developed countries. As our human population grows, new homes, communities, and expansions of cities will occur. Connecting all of the new expansions will be roads, a very important part in our daily life. Rural roads promote economic development but also facilitate deforestation. About 90% of the deforestation has occurred within 100 km of roads in most parts of the Amazon.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

1. The undesirable change in physical, chemical and biological characteristics of our air, land and water is called ----------

2. Air is mainly a mixture of various gases such as oxygen, carbon dioxide and ----------.

3. ----------is a consequence of green house effect caused by increased level of carbon dioxide (CO_2).

4. Insecticides and other pesticides are ---------- pollutants.

2.6 LOSS OF BIODIVERSITY

The continuous loss of biodiversity due to over exploitation, habitat degradation, deforestation and land pollution has posed serious threat to the very existence of the mankind. It has been calculated that if this trend of biodepletion continues, about 1/4th of the world species may be extinct by the year 2050. The rate of destruction which has been of the order of one species per year over the past 600 million years is today feared to be dozens of species a day. Hence, the conservation of biodiversity has become one of the most pressing environmental issues. The challenge is for nations, government agencies, organizations and individuals to protect and enhance biological diversity, while continuing to meet people's need for natural resources.

We are at a major turning point in human history and for the first time, we now have the resources, motivation, and knowledge to protect our environment and to build a sustainable future for ourselves and our children. Until recently, we didn't have these opportunities, or there was not enough clear evidence to inspire people to change their behavior and invest in environmental protection; now the need is obvious to nearly everyone. Unfortunately, this also may be the last opportunity to act before our problems become irreversible.

2.6.1 Noise pollution

High level noise is a disturbance to the human environment. Because of urbanization, noise in all areas in a city has increased considerably. One of the most pervasive sources of noise in our environment today is those associated with transportation. People reside adjacent to highways, are subjected to high level of noise produced by trucks and vehicles pass on the highways. Prolonged exposure to high level of noise is very much harmful to the health of mankind.

In industry and in mines the main sources of noise pollution are blasting, movement of heavy earth moving machines, drilling, crusher and coal handling plants etc. The critical value for the development of hearing problems is at 80 decibels.

Chronic exposure to noise may cause noise-induced hearing loss. High noise levels can contribute to cardiovascular effects. Moreover, noise can be a causal factor in workplace accidents.

2.6.2 Climate Change

The rising concentrations of greenhouse gases (GHGs) of anthropogenic origin in the atmosphere such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have increased, since the late 19th century. According to the Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change, because of the increase in concentration of greenhouse gases in the atmosphere (for e.g., CO_2 by 29 per cent, CH_4 by 150 per cent and N_2O by 15 per cent) in the last 100 years, the mean surface temperature has risen by 0.4–0.8°C globally. The precipitation has become spatially variable and the intensity and frequency of extreme events has increased. The sea level also has risen at an average annual rate of 1–2 mm during this period. The continued increase in concentration of GHG in the atmosphere is likely to lead to climate change resulting in large changes in ecosystems, leading to possible catastrophic disruptions of livelihoods, economic activity, living conditions, and human health. The United Nations Framework Convention on Climate Change requires the parties to protect the climate system in accordance with their 'common but differentiated responsibilities' and respective capabilities. In the year 1990, the developed world (Australia, Canada, USA, Europe, former USSR and Japan) emitted around 66 per cent of the total global GHG emissions, which though has reduced to 54 per cent in 2000, mainly offset by the rise in Chinese emissions. The South Asian region, including three fourths emission share of India, contributed only 3 per cent of the total global GHG emissions in 1990 and the share of emissions from South Asia has grown merely by 4 per cent in 2000.

2.6.3 Fundamentals of prevention and control of air pollution

As mentioned above, air pollutants can be gaseous or particulate matters. Different techniques for controlling these pollutants are discussed below

a. Methods of controlling gaseous pollutants

1. Combustion – This technique is used when the pollutants are in the form of organic gases or vapors. During flame combustion or catalytic process, these organic pollutants are converted into water vapor and relatively less harmful products, such as CO2.

2. Absorption – In this technique, the gaseous effluents are passed through scrubbers or absorbers. These contain a suitable liquid absorbent, which removes or modifies one or more of the pollutants present in the gaseous effluents.

3. Adsorption – The gaseous effluents are passed through porous solid adsorbents kept in suitable containers. The organic and inorganic constituents of the effluent gases are trapped at the interface of the solid adsorbent by physical adsorbent.

b. Methods to control particulate emissions

1. Mechanical devices generally work on the basis of the following

(i) Gravity: In this process, the particles settle down by gravitational force.

(ii) Sudden change in direction of the gas flow. This causes the particles to separate out due to greater momentum.

2. Fabric Filters: The gases containing dust are passed through a porous medium. These porous media may be woven or filled fabrics. The particles present in the gas are trapped and collected in the filters. The gases freed from the particles are discharged.

3. Wet Scrubbers: Wet scrubbers are used in chemical, mining and metallurgical industries to trap SO_2, NH3, metal fumes, etc.

4. Electrostatic Precipitators: When a gas or an air stream containing aerosols in the form of dust, fumes or mist, is passed between two electrodes, then, the aerosol particles get precipitated on the electrode.

c. Other practices in controlling air pollution – Apart from the above, following practices also help in controlling air pollution.

(i) Use of better designed equipment and smokeless fuels, hearths in industries and at home.

(ii) Automobiles should be properly maintained and adhere to recent emission-control standards.

(iii) More trees should be planted along road side and houses.

(iv) Renewable energy sources, such as wind, solar energy, ocean currents, should fulfill energy needs.

(v) Tall chimneys should be installed for vertical dispersion of pollutants.

d. General air pollution control devices / equipments for industries – The commonly used equipments / process for control of dust in various industries are (a) Mechanical dust collectors in the form of dust cyclones; (b) Electrostatic precipitators – both dry and wet system; (c) particulate scrubbers; (d) Water sprayer at dust generation points; (e) proper ventilation system and (f) various monitoring devices to know the concentration of dust in general body of air.

The common equipments / process used for control of toxic / flue gases are the (a) process of desulphurisation; (b) process of denitrification; (c) Gas conditioning etc. and (d) various monitoring devices to know the efficacy of the systems used.

e. Steps, in general, to be taken for reduction of air pollution – To change our behavior in order to reduce air pollution at home as well as on the road, few following small steps taken by us would lead to clean our Environment.

At Home

1. Avoid using chemical pesticides or fertilizers in your yard and garden. Many fertilizers are a source of nitrous oxide, a greenhouse gas that contributes to global warming. Try organic products instead.

2. Compost your yard waste instead of burning it. Outdoor burning is not advisable, as it pollutes air. Breathing this smoke is bad for you, your family and your neighbours. Plus, you can use the compost in your garden.

3. If you use a wood stove or fireplace to heat your home, it would be better to consider switching to another form of heat which does not generate smoke. It is always better to use sweater or warm clothing than using fireplace.

4. Be energy efficient. Most traditional sources of energy burn fossil fuels, causing air pollution. Keep your home well-maintained with weather-stripping, storm windows, and insulation. Lowering your thermostat can also help – and for every two degrees Fahrenheit you lower it, you save about two percent on your heating bill.

5. Plant trees and encourage other to plant trees as well. Trees absorb and store carbon dioxide from the atmosphere, and filter out air pollution. During warmer days, trees provide cool air, unnecessary use of energy on air conditioning is avoided, hence the air pollution.

6. Try to stop smoking; at home, at office or at outside. Tobacco smoking not only deteriorates personal health, it affects others health too.

On the Road

7. Keep your vehicle well maintained. A poorly maintained engine both creates more air pollution and uses more fuel. Replace oil and air filters regularly, and keep your tires properly inflated.

8. Drive less. Walking, bicycling, riding the bus, or working from home can save you money as well as reducing air pollution.

9. Don’t idle your vehicle. If you stop for more than 30 seconds, except in traffic, turn off your engine.

10. Don’t buy more car than you need. Four-wheel drive, all-wheel drive, engine size, vehicle weight, and tire size all affect the amount of fuel your vehicle uses. The more fuel it uses the more air pollution it causes.

2.6.4 Water pollution prevention and control

Water is a key resource for our quality of life. It also provides natural habitats and eco-systems for plant and animal species. Access to clean water for drinking and sanitary purposes is a precondition for human health and well-being. Clean unpolluted water is essential for our ecosystems. Plants and animals in lakes, rivers and seas react to changes in their environment caused by changes in chemical water quality and physical disturbance of their habitat.

Water pollution is a human-induced change in the chemical, physical, biological, and radiological quality of water that is injurious to its existing, intended, or potential uses such as boating and swimming, the consumption of fish, and the health of aquatic organisms and ecosystems. Thus, the discharge of toxic chemicals from a pipe or the release of livestock waste into a nearby water body is considered pollution. The contamination of ground water, rivers, lakes, wetlands and oceans can threaten the health of humans and aquatic life.

Contaminants have a significant impact on aquatic ecosystems. For example, enrichment of water bodies with nutrients (principally nitrogen and phosphorus) can result in the growth of algae and other aquatic plants that shade or clog streams. Direct exposures to toxic chemicals such as pesticides, is also a health concern for individual aquatic plants and animals. Without healthy water for drinking, cooking, fishing, and farming, the human race would perish. Clean water is also necessary for recreational interests such as swimming and boating.

a. Sources of Water Pollution – Sources of water pollution are generally divided into two categories. The first is point-source pollution, in which contaminants are discharged from a discrete location. Sewage outfalls and oil spills are examples of point-source pollution. The second category is non-point-source or diffuses pollution, referring to all of the other discharges that deliver contaminants to water bodies.

Numerous manufacturing plants pour off undiluted corrosives, poisons, and other noxious byproducts to water streams. The construction industry discharges slurries of gypsum, cement, abrasives, metals, and poisonous solvents. The mining industry also presents persistent water pollution problems. In yet another instance of pollution, hot water discharged by factories and power plants causes so-called 'thermal pollution' by increasing water temperatures. Such increases change the level of oxygen dissolved in a body of water, thereby disrupting the water's ecological balance, killing off some plant and animal species while encouraging the overgrowth of others. Towns and municipalities are also major sources of water pollution.

In many public water systems, pollution exceeds safe levels. One reason for this is that much groundwater has been contaminated by wastes pumped underground for disposal or by seepage from surface water. When contamination reaches underground water tables, it is difficult to correct and spreads over wide areas. Discharge of untreated or only partially treated sewage into the waterways threatens the health of their own and neighboring populations as well. Along with domestic wastes, sewage carries industrial contaminants and a growing tonnage of paper and plastic refuse. Although thorough sewage treatment would destroy most disease-causing bacteria, the problem of the spread of viruses and viral illness remains. Additionally, most sewage treatment does not remove phosphorus compounds, contributed principally by detergents.

b. Dangers of Water Pollution **–** Virtually all water pollutants are hazardous to humans as well as lesser species; sodium is implicated in cardiovascular disease, nitrates in blood disorders. Mercury and lead can cause nervous disorders. Some contaminants are carcinogens. DDT is toxic to humans and can alter chromosomes. Along many shores, shellfish can no longer be taken because of contamination by DDT, sewage, or industrial wastes.

c. Prevention and Control of Water Pollution **–** Sewage should be treated before it is discharged into the river or ocean. This is possible through modern techniques.

Sewage is first passed through a grinding mechanism. This is then passed through several settling chambers and neutralized with lime. Up to this stage, the process is called primary treatment. The sewage still contains a large number of pathogenic and non-pathogenic

organisms, and also sufficient quantity of organic matter. The neutralized effluents are sent to UASB (up-flow anaerobic sludge blanket). It is a reactor. In this, the anaerobic bacteria degrade the biodegradable material present in the waste water. This removes foul odor and releases methane, which can be used elsewhere. In this system, the pollution load is reduced upto 85 percent. After this, water is sent to aeration tanks where it is mixed with air and bacteria. Bacteria digest the organic waste material. This is called biological or secondary treatment. Even after the treatment, water is not yet fit for drinking. The harmful microorganisms need to be killed. The final step (tertiary treatment) is, therefore, a disinfection process, to remove final traces of organics, bacteria, dissolved inorganic solids, etc. For tertiary treatment, methods, such as chlorination, evaporation, and exchange absorption may be employed. These depend upon the required quality of the final treatment. Apart from the above, you should also adopt the following practices.

(i) Waste food material, paper, decaying vegetables and plastics should not be thrown into open drains.

(ii) Effluents from distilleries, and solid wastes containing organic matter should be sent to biogas plants for generation of energy.

(iii) Oil slicks should be skimmed off from the surface with suction device. Sawdust may be spread over oil slicks to absorb the oil components.

2.6.5 Soil erosion and its prevention

Soil erosion by water, wind and tillage affects both agriculture and the natural environment. Soil loss, and its associated impacts, is one of the most important (yet probably the least well-known) of today's environmental problems. It is mostly due to poor land use practices, which include deforestation, overgrazing, unmanaged construction activity and road or trail building.

Soil is a complex mixture of living and non-living materials. It provides anchorage and sustenance to plants. Natural agents like water and wind, constantly tend to remove the top soil and cause erosion. Rain falling upon the unprotected top soil, washes it down into the streams.

Due to the absence of plant covering, eroded soil cannot hold water. Water rushes into the rivers and overflows as flood. Dust storm also causes soil erosion. The particles of top soil are picked up in such quantities that they form clouds of dust. Human beings also cause soil erosion. The growing human habitation and expansion of urban areas lead to removal of vegetation. Once vegetation is removed, the naked soil gets exposed to wind and water. Improper tillage is another cause of soil erosion. Farmers often loosen the top soil for removing weeds and preparing seed beds. They also leave agricultural fields lying fallow for long time. These practices expose the top soil to the wind and cause erosion.

Soil erosion is always a result of mankind's unwise actions, such as overgrazing or unsuitable cultivation practices. These leave the land unprotected and vulnerable. Accelerated soil erosion by water or wind may affect both agricultural areas and the natural environment, and is one of the most widespread of today's environmental problems. Soil erosion is just one form of soil degradation. Other kinds of soil degradation include salination, nutrient loss, and compaction.

Prevention of soil erosion **–** Plants provide protective cover on the land and prevent soil erosion for the following reasons.

(a) plants slow down water as it flows over the land (runoff) and this allows much of the rain to soak into the ground;

(b) plant roots hold the soil in position and prevent it from being washed away;

(c) plants break the impact of a raindrop before it hits the soil, thus reducing its ability to erode;

(d) plants in wetlands and on the banks of rivers are of particular importance as they slow down the flow of the water and their roots bind the soil, thus preventing erosion.

Preventing soil erosion requires technical changes to adopt. Aspects of technical changes include:

(i) Use of contour ploughing and wind breaks;

(ii) Leaving unplugged grass strips between ploughed land;

(iii) To make sure that there are always plants growing on the soil, and that the soil is rich in humus (decaying plant and animal remains). This organic matter is the “glue” that binds the soil particles together and plays an important part in preventing erosion;

(iv) To avoid overgrazing and the over-use of crop lands;

(v) Allow indigenous plants to grow along the river banks instead of ploughing and planting crops right up to the water’s edge;

(vi) Encouraging biological diversity by planting several different types of plants together;

(vii) Conservation of wetlands.

We can check soil erosion by adopting the following additional practices:

1. Intensive cropping and use of proper drainage canals.

2. Terracing on the sloping fields. This retards the speed of the flowing water.

3. Planting trees and sowing grasses.

4. Extensive aforestation practices to be carried out.

2.6.6 Mitigation of Noise pollution

Reducing noise pollution by muffling the sounds at the source is one of the best methods in industry and for urban living. Protective equipment is generally mandatory when noise levels exceed 85 dB(A) in industry. Creation of green cover adjacent to municipal roads and in mines is the way to mitigate noise pollution. It has been observed that noise level reduces by 10 decibels per every 10m wide green belt development. Apart, redesigning industrial equipment, shock mounting assemblies and physical barriers in the workplace are also for reduction and exposure of unwanted industrial noise.

High way noise pollution can be mitigated by constructing noise barriers. Artificial noise barriers are solid obstructions built between the highway and the residential areas along a highway. They block major portion of noise produced by passing vehicles on a highway. Effective noise barriers typically reduce noise levels by as much as half or more. The construction of noise barrier may be built in the form of earth mounds, vertical wall along the highways for creation of blockage of sound generated by heavy vehicles. Creation of greenbelt in the space between the residences and highways also reduces the noise nuisance.

2.7 CONSERVATION AND PROTECTION OF ENVIRONMENT

By now, all of us have realized how important it is to protect the environment for our own survival. The term 'conservation' of environment relates to activities which can provide individual or commercial benefits, but at the same time, prevent excessive use leading to environmental damage. Conservation may be distinguished from preservation, which is considered to be "maintaining of nature as it is, or might have been before the intervention of either human beings or natural forces." We know that natural resources are getting depleted and environmental problems are increasing. It is, therefore, necessary to conserve and protect our environment.

Following practices help in protecting our environment.

1. Rotation of crops.

2. Judicious use of fertilizers, intensive cropping, proper drainage and irrigation.

3. Treatment of sewage, so that it does not pollute the rivers and other water bodies.

4. Composting organic solid waste for use as manure.

5. Planting trees in place of those removed for various purposes.

6. National parks and conservation forests should be established by the government.

7. Harvesting of rain water.

Some action points to protect or improve the environment

(i) Dispose the waste after separating them into biodegradable and non-biodegradable waste material.

(ii) Start a compost heap or use a compost bin. This can be used to recycle waste food and other biodegradable materials.

(iii) Avoid unnecessary or wasteful packaging of products.

(iv) Reusable bags.

(v) Plant trees. They will help to absorb excess carbon dioxide.

(vi) Observe World Environment Day on 5th June.

(vii) Never put any leftover chemicals, used oils down the drain, toilet or dump them on the ground or in water or burn them in the garden. If you do so, it will cause pollution.

(viii) Don't burn any waste, especially plastics, for the smoke may contain polluting gases.

(ix) Use unleaded petrol and alternate sources of energy, and keep the engine properly tuned and serviced and the tyres inflated to the right pressure, so that vehicle runs efficiently.

(x) Avoid fast starts and sudden braking of automobiles.

(xi) Walk or cycle where it is safe to do so – walking is free; cycling can help to keep you fit.

(xii) Use public transport wherever you can, or form a car pool for everyday travel.

(xiii) Send your waste oil, old batteries and used tyres to a garage for recycling or safe disposal; all these can cause serious pollution.

Check Your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

5. Absorption is the technique, the gaseous effluents are passed through scrubbers or ----------.

6. The organic and inorganic constituents of the effluent gases are trapped at the interface of the solid adsorbent by ----------.

7. The gases containing dust are passed through a porous medium is called ----------.

8. At home avoid using chemical pesticides or fertilizers in your ----------.

2.8 LET US SUM UP

In this unit you have studied in detail about the Environmental Pollution. You have learned about the various Pollutions i.e., Air Pollution, Water Pollution, Soil Pollution, Noise Pollution and E-waste. And you have studies the various strategies for controlling environmental pollutions. You have understood the concepts of conservation and protection of environment.

2.9 EVALUATION

1. Define the term Environmental Pollution.
2. Explain the term Biodegradable pollutants.
3. Explain the term Non-Biodegradable pollutants.
4. What is Air Pollution? Explain it.
5. Explain the strategies for controlling the Water Pollution.
6. Explain the Soil Pollution.
7. What is E-waste?
8. Explain the Strategies for controlling Noise Pollution.
9. Explain in detail on Soil erosion and its prevention.
10. Discuss briefly on Conservation and protection of environment.

UNIT - END ACTIVITIES

- List out the causes for environmental pollution.
- Identify the suitable strategies to control environmental pollution at your home.

POINTS FOR DISCUSSION

- "Industrialisation and population explosions are major causes for environmental pollution"-discuss.

ANSWER TO CHECK YOUR PROGRESS

1. Environmental Pollution.
2. Nitrogen.
3. Global warming.
4. Non-bio degradable.
5. Absorbers.
6. Physical adsorbent.
7. Fabric Filters.
8. Garden.

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan "Environmental science education" Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P "Environmental Education", Ram Publishers, Chennai.(2002).
3. Veera Bala Rastogi and Jayaraj "Animal ecology and distribution of animals", Kedar Nath Ram nath, New Delhi. (1984).

INDIA AND ENVIRONMENTAL ISSUES AND POLICIES

UNIT – III

STRUCTURE

3.1 INTRODUCTION

The threats of environment are mostly man-made. The process of deforestation, indiscriminate killing of wild animals, birds and plant species, urbanization industrial and misuse of natural resources by a rapidly growing popular pose serious problems to sustainable growth. The developments in our society have brought serious consequences on environment. The forest products including firewood, timber and minor products withdrawn every year are beyond estimated sustainable levels. Many species of insects, birds and other animals and plants are in danger of extinction. Western and Eastern Ghats regions and the Himalayan regions are affected by the environmental degradation. Oil pollution, deterioration of coral reefs and over-fishing are the major threats to marine eco-system. The net result is environmental degradation and depletion of natural resources. Hence, it is indispensable to conserve the natural resources. In the previous unit, we have learnt about the different types of pollution and the way of prevention. In this unit let us discuss about the sustainable development in order to protect our environment.

3.2 OBJECTIVES

At the end of the unit, you will be able to

- Define the term environmental awareness
- Understand the concept of ethics
- Identify the environmental problems of India
- Recognize the need of nature conservation
- Explain the in-situ conservation
- Explain the ex-situ conservation

3.3 ENVIRONMENTAL AWARENESS

The rationale for environmental awareness can be summarized as the following:

1. A major goal of environmental education in India as entrenched in National policy on Education is the provision of the expertise that can utilize scientific knowledge towards the preservation and solution of environmental problems. Knowledge about the changes that have altered the environment -land, water, weather, and vegetation; social, cultural and political

environment are essential components of environmental education. Consequently, the general populace should be equipped with all these to be able to solve the problems of the environment.

2. India's socio-economic development (like any other less developed country) is firmly rooted on the exploitation of the natural resources in our environment. Land, water, forest and other mineral resources utilization is the dominant feature of rural economy with agriculture the driving force. Uncontrolled and improper exploitation of these resources have implications on the environment causing disruption in the living standard, starvation, displacement and human suffering. Environmental Education is therefore necessary to create awareness of the causes and effects of these problems viz: food and water scarcity, pollution, outbreak of epidemics and natural disaster such as flood, erosion and desert encroachment, and of course how to prevent them.

3. Environmental education is needed to foster international co-operation and understanding. The developed countries rely on the high technology for the exploitation of natural resources while developing countries like India totally depend on agriculture, forestry and the mineral resources thereby leading to intensive and over-exploitation of the natural resources and these have serious implications on the resources.

4. Public enlightenment on the impact of government policies on local environment should be useful both to the government and the local people.

5. Awareness of such global environmental issues is an essential component of environmental education which ordinary citizen should be aware of.

6. Environmental education for the over-all social and economic emancipation of women and children. These form a substantial percentage in the utilization of natural resources especially at the rural setting.

7. Environmental education is very essential for the lack of it. Environmental Education is virtually a new thing in this part of the world.

8. Environment education is also very essential for our survival on earth. The natural resources and cultural heritage need to be protected not only for this generation but for future generation.

3.3.1 Objectives of Environmental Awareness

The general objectives of environmental education include the following:

1. To enlighten the people on the physical components of the environment

2. To inform them about their dependence on the environmental resources

3. To enlighten them about the changes in the environment in the last decade and the consequences of their present actions.

4. To alert them about the consequences of human actions on the environment both on man himself and other forms of life

5. To create concern for environmental quality and conservation and to foster understanding of man's relationship and interactions with the ecosphere

6. To develop personal, community and national sanitation and conservation ethics

7. To kindle a sense of responsibility that will motivate ordinary citizen to seek and acquire more knowledge about the environment and its problems and propagate such knowledge to others in the community

8. To awaken appreciation of the aesthetic quality of nature in order to encourage its uses for recreation.

3.3.2 The objectives of environmental education are summarized by UNESCO/UNEP

1. Awareness: Environmental education should foster appreciation of environment. It should help different groups and individuals to acquire awareness of and sensitivity to the overall environment and its allied problems.

2. Knowledge: Environmental education should help social groups and individual gain a variety of experience in and acquire a basic understanding of the environmental and its associated problems. The people should he informed of their roles in causing environmental problems around them — deforestation, overgrazing, bush burning, desertification, erosion, loss of soil fertility etc

3. Attitude: Environmental education should help acquire a set of values and feelings of concern for the environment and the motivation for active participation in environmental improvement and protection programmes. Individuals and groups need to adopt ethical values that awaken strong feelings for the environment and all its living and non-living components

4. Skill: Environmental education should foster and assist in conservation practices and the skill needed to prevent environmental degradation e.g. erosion control through the uses of biological and mechanical methods. The people should be taught how to mobilize their human and natural resources to prevent ecological problems.

5. Evaluation: Environmental education should enable the people to assess government programmes and land management practices that are being introduced.

6. Participation: Environmental education should provide opportunity for social groups and individuals to be actively involved at all levels involved in working towards resolution of environmental problems.

3.3.3 Strategies for Environmental Awareness

Various strategies have been proposed for the introduction of environmental education into school curricula and into non-formal education. These include the following:

1. Introduction of environmental studies as a distinct and special subject, taught by specially trained teachers.

2. Introduction of environmental issues into the various traditional subjects

3. The re-orientation of the subject matter in the traditional schools to be in accord with the scope, aims, objectives, strategies and guiding principles of environmental education.

4. The re-evaluation and re-structuring of the entire contents of various subjects to incorporate environmental education

5. Integration of the contents of the various subjects within the framework that relate to the major environmental problems.

3.4 ENVIRONMENTAL PROBLEMS OF INDIA

Effects of man on the environment components of the environment

Environment is the total combination of natural objects (living and non living), objects made by human beings, the interrelationship between these conditions and various circumstances which surround people on earth.

The following are the components of the environment.

1. Living natural physical things:
- Plants (different types of vegetation)
- Human beings and other types of animals
- Small living things like fungi (e g mushroom), bacteria and viruses
2. Non-Living physical things
- Land surface and different kinds of rocks
- Water in the forms of lakes, lagoon, river, sea, ocean etc
- Atmospheric gas

1. Features made by human beings — human settlement and infrastructures, road, bridges etc.

2. Cultural relationship and institutions — political, economical, social/law, religion etc.

Types of environmental disruptions

1. ***Over-population***: This is the presence in a given area of more people that can be supported adequately by the available resources

2. ***Pollution***: This is the introduction of substances or impurities that reduce the quality of the environment — air pollution by smokes, industries etc

3. ***Depletion of resources***: a material is depleted as it becomes less available for its intended uses. This may be caused by

    - destruction
    - Dilution or displacement
    - Pollution

4. Change in global condition leading to climate change and extinction of species.

5. ***War***: this combines all the environmental problems. Disruption of the environment by war may be caused during the preparation for the war and during actual hostility

3.5 ENVIRONMENTAL ETHICS

Environmental ethics is a branch of ethics that studies the relation of human beings and the environment and how ethics play a role in this. Environmental ethics believe that humans are a part of society as well as other living creatures, which includes plants and animals. These items are a very important part of the world and are considered to be a functional part of human life. Thus, it is essential that every human being respect and honor this and use morals and ethics when dealing with these creatures.

" *Environmental ethics is a branch of applied philosophy that studies the conceptual foundations of environmental values as well as more concrete issues surrounding societal attitudes, actions, and policies to protect and sustain biodiversity and ecological systems.*"

According to Wikipedia, "*Environmental ethics is the part of environmental philosophy which considers extending the traditional boundaries of ethics from solely including humans to including the non-human world. It exerts influence on a large range of disciplines including environmental law, environmental sociology, ecotheology, ecological economics, ecology and environmental geography.*"

Environmental ethics are a key feature of environmental studies, that establishes relationship between humans and the earth. With environmental ethics, you can ensure that you are doing your part to keep the environment safe and protected. Every time that a tree is cut down to make a home or other resources are used we are using natural resources that are becoming more and more sparse to find. It is essential that you do your part to keep the environment protected and free from danger. It is not as difficult to do as you may think so long as you're willing to make a few simple and easy changes.

With the rapid increase in world's population, the consumption of natural resources has increased several times. This has degraded our planet's ability to provide the services we humans need. The consumption of resources is going at a faster rate than they can naturally replenish.

Environmental ethics builds on scientific understanding by bringing human values, moral principles, and improved decision making into conversation with science. It was Earth Day in 1970 that helped to develop environmental ethics in the US, and soon thereafter the same ethics were developed in other countries including Canada and North America. This is important because the ethics of the environment are of major concern these days.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

1. The main objective of ---------- movement was to ensure an ecological balance.
2. In Biosphere Reserves ---------- zone lies between the core and transition zone.
3. The main functions of biodiversity reserves are

(a) Conservation (b) Development

(c) Scientific Research (d) All the above

3.7 CONSERVATION OF BIODIVERSITY

Human beings have been directly or indirectly dependent on biodiversity for sustenance to a considerable extent. However, increasing population pressure and developmental activities have led to large scale depletion of the natural resources.

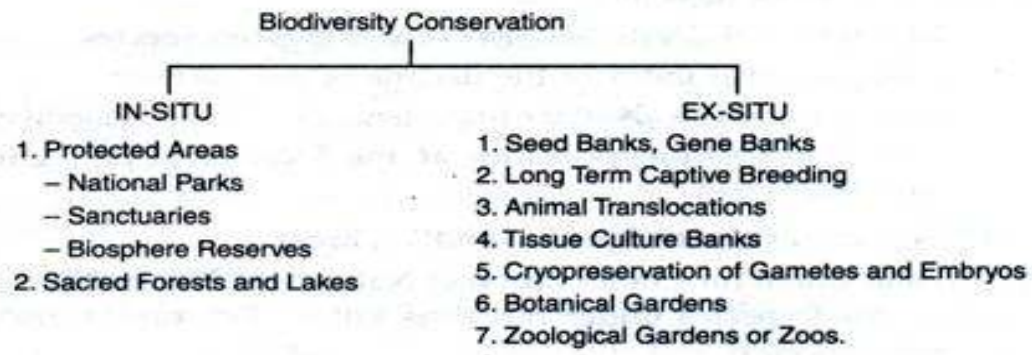
Conservation is the protection, preservation, management, or restoration of wildlife and natural resources such as forests and water. Through the conservation of biodiversity and the survival of many species and habitats which are threatened due to human activities can be ensured. There is an urgent need, not only to manage and conserve the biotic wealth, but also restore the degraded ecosystems.

Types of Conservation

Conservation can broadly be divided into two types

1. In-situ conservation

2. Ex-situ conservation



In-situ Conservation

In-situ conservation is on site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species.

It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators.

It is applied to conservation of agricultural biodiversity in agro forestry by farmers, especially those using unconventional farming practices. In-situ conservation is being done by declaring area as protected area.

In India following types of natural habitats are being maintained

1. National Parks

INDIA has over 600 protected areas, which includes over 90 national parks, over 500 animal sanctuaries and 15 biosphere reserves.

A national park is an area which is strictly reserved for the betterment of the wildlife and where activities like forestry, grazing on cultivation are not permitted. In these parks, even private ownership rights are not allowed.

Their boundaries are well marked and circumscribed. They are usually small reserves spreading in an area of 100 Sq. km. to 500 sq. km. In national parks, the emphasis is on the preservation of a single plant or animal species.

List of some major National Parks of India

S.No	Name	State	Established Year	Area (in km^2)
1	Corbett National Park	Uttarkand	1921	1318.5
2	Dudhwa National Park	Uttar Pradesh	1977	490.29
3	Gir National Park	Gujarat	1965	258.71
4	Kanha National Park	Madhya Pradesh	1955	940
5	Kanger Ghati National Park (Kanger Valley)	Chhattisgarh	1982	200
6	Kaziranga National Park	Assam	1974	471.71
7	NandaDevi National Park	Uttarakhand	1982	630.33
8	Sariska National Park	Rajasthan	1955	866
9	Silent Valley National Park	Kerala	1980	237
10	Sundarbans National Park	West Bengal	1984	1330.12

2. Wildlife Sanctuaries

A sanctuary is a protected area which is reserved for the conservation of only animals and human activities like harvesting of timber, collecting minor forest products and private ownership rights are allowed as long as they do not interfere with well-being of animals. Boundaries of sanctuaries are not well defined and controlled biotic interference is permitted, e.g., tourist activity.

List of some major Wildlife Sanctuaries of India

S.No	Name	State	Established year	Area (in km^2)
1	Ghana Bird Sanctuary	Rajasthan	1982	28.73
2	HazaribagWildlife Sanctuary	Jharkand	1954	183.89
3	Mudhumalai wildlife Sanctuary	Tamilnadu	1940	321.55
4	Jaldapara wildlife Sanctuary	West Bengal	2012	216
5	Mount Abu wildlife Sanctuary	Rajasthan	1960	288.84
6	Aanamalai wildlife Sanctuary (Indira Gandhi wildlife sanctuary)	Tamilnadu	1989	117.10

3. Biosphere Reserves

It is a special category of protected areas where human population also forms a part of the system. They are large protected area of usually more than 5000 sq.km. A biosphere reserves has 3 parts- core, buffer and transition zone.

1. Core zone is the inner zone; this is undisturbed and legally protected area.

2. Buffer zone lies between the core and transition zone. Some research and educational activities are permitted here.

3. Transition zone is the outermost part of biosphere reserves. Here cropping, forestry, recreation, fishery and other activities are allowed.

The main functions of biodiversity reserves

1. Conservation

To ensure the conservation of ecosystem, species and genetic resources.

2. Development

To promote economic development, while maintaining cultural, social and ecological identity.

3. Scientific Research

To provide support for research related to monitoring and education, local, national and global issues.

Biosphere reserves serve in some ways as 'living laboratories' for testing out and demonstrating integrated management of land, water and biodiversity.

List of some major Biosphere Reserves of India

S.No	Name	State	Established Year	Area (in km^2)
1	Nanda devi	Uttarakand	1982	5,860.69
2	Manas	Assam	1990	2837
3	Gulf of Mannar	Tamilnadu	1980	10,500
4	Great Nicobar	Andaman Nicobar Islands	1989	885
5	Panchmarthi	Madhaya Pradesh	1999	4926.28

Advantages of in-situ conservation

1. The flora and fauna live in natural habitats without human interference.

2. The life cycles of the organisms and their evolution progresses in a natural way.

3. In-situ conservation provides the required green cover and its associated benefits to our environment.

4. It is less expensive and easy to manage.

5. The interests of the indigenous people are also protected.

Ex-Situ Conservation

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. This involves conservation of genetic resources, as well as wild and cultivated or species, and draws on a diverse body of techniques and facilities. Such strategies include establishment of botanical gardens, zoos, conservation strands and gene, pollen seed, seedling, tissue culture and DNA banks.

i. Seed gene bank

These are cold storages where seeds are kept under controlled temperature and humidity for storage and this is easiest way to store the germ plasma of plants at low temperature. Seeds preserved under controlled conditions (minus temperature) remain viable for long durations of time.

ii. Gene bank

Genetic variability also is preserved by gene bank under normal growing conditions. These are cold storages where germ plam are kept under controlled temperature and humidity for storage; this is an important way of preserving the genetic resources.

iii. Cryopreservation

This is the newest application of technology for preservation of biotic parts. This type of conservation is done at very low temperature (-196°C) in liquid nitrogen. The metabolic activities of the organisms are suspended under low temperature, which are later used for research purposes.

iv. Tissue culture bank

Cryopreservation of disease free meristems is very helpful. Long term culture of excised roots and shoots are maintained. Meristem culture is very popular in plant propagation as it's a virus and disease free method of multiplication.

v. Long term captive breeding

The method involves capture, maintenance and captive breeding on long term basis of individuals of the endangered species which have lost their habitat permanently or certain highly unfavourable conditions are present in their habitat.

vi. Botanical gardens

A botanical garden is a place where flowers, fruits and vegetables are grown. The botanical gardens provide beauty and calm environment. Most of them have started keeping exotic plants for educational and research purposes.

vii. Animal Translocation

Release of animals in a new locality which come from anywhere else.

Translocation is carried in following cases

1. When a species on which an animal is dependent becomes rare.

2. When a species is endemic or restricted to a particular area.

3. Due to habit destruction and unfavourable environment conditions.

4. Increase in population in an area.

viii. Zoological Gardens

In zoos wild animals are maintained in captivity and conservation of wild animals (rare, endangered species). The oldest zoo, the Schonbrumm zoo which exists today also, was established in VIENNA in 1759.

In India, the 1st zoo came into existence at BARRACKPORE in 1800. In world there are about 800 zoos. Such zoos have about 3000 species of vertebrates. Some zoos have undertaken captive breeding programmes.

Advantages of ex-situ preservation

1. It is useful for declining population of species.

2. Endangered animals on the verge of extinction are successfully breeded.

3. Threatened species are breeded in captivity and then released in the natural habitats.

4. Ex-situ centres offer the possibilities of observing wild animals, which is otherwise not possible.

5. It is extremely useful for conducting research and scientific work on different species.

3.7 IUCN RED LIST (International Union for the Conservation of Nature)

The goal of The IUCN Red List is

- To provide information and analyses on the status, trends and threats to species in order to inform and catalyse action for biodiversity conservation.

This goal includes the "traditional" role of The IUCN Red List in identifying particular species at risk of extinction. While the role of The IUCN Red List in underpinning priority-setting processes for single species remains of critical importance, the goal has been expanded to encompass the use of data from the Red List for multi-species analyses in order to identify and monitor trends in species status and to catalyse appropriate conservation action.

To achieve this goal, The IUCN Red List aims to

- Establish a baseline from which to monitor the change in status of species;
- Provide a global context for the establishment of conservation priorities at the local level;
- Monitor, on a continuing basis, the status of a representative selection of species (as biodiversity indicators) that cover all the major ecosystems of the world.

The high profile, standards and scientific integrity of The IUCN Red List are maintained in the following ways:

- The scientific aspects underpinning The IUCN Red List are regularly published in the scientific literature;
- The assessment process is clear and transparent;
- The listings of species are based on correct use of the IUCN Red List Categories and Criteria and are open to challenge and correction;
- All assessments are appropriately documented and supported by the best scientific information available;
- The data are freely available through the World Wide Web to all potential users;
- The IUCN Red List is updated regularly, but not all species are reassessed with each update – many assessments simply roll-over from the previous edition; and
- Analyses of the findings of The IUCN Red List are regularly published, approximately every four to five years, usually at the time of the World Conservation Congress.

The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for the Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. A series of Regional Red Lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit.

The IUCN Red List is set upon precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction.

According to IUCN (1996), the formally stated goals of the Red List are:

(1) to provide scientific based information on the status of species and subspecies at a global level,

(2) to draw attention to the magnitude and importance of threatened biodiversity,

(3) to influence national and international policy and decision-making, and

(4) to provide information to guide actions to conserve biological diversity.

Major species assessors include Bird Life International, the Institute of Zoology (the research division of the Zoological Society of London), the World Conservation Monitoring Centre, and many Specialist Groups within the IUCN Species Survival Commission(SSC). Collectively, assessments by these organizations and groups account for nearly half the species on the Red List.

The IUCN aims to have the category of every species re-evaluated every five years if possible, or at least every ten years. This is done in a peer reviewed manner through IUCN Species Survival Commission (SSC) Specialist Groups, which are Red List Authorities responsible for a species, group of species or specific geographic area, or in the case of Bird Life International, an entire class

3.8 Red List of Threatened Plants

The 1964 IUCN Red List of Threatened Plants used the older pre-criteria Red List assessment system. Plants listed may not, therefore, appear in the current Red List. IUCN advise that is best to check both the online Red List and the 1997 plants Red List publication.

2006 release

The 2006 Red List, released on 4 May 2006 evaluated 40,168 species as a whole, plus an additional 2,160 subspecies, varieties, aquatic stocks, and subpopulations.

2007 release

On 12 September 2007, the World Conservation Union (IUCN) released the 2007 IUCN Red List of Threatened Species. In this release, they have raised their classification of both the western lowland gorilla and the Cross River gorilla from endangered to critically endangered, which is the last category before extinct in the wild, due to Ebola virus and poaching, along with other factors. Russ Mittermeier, chief of Swiss-based IUCN's Primate Specialist Group, stated that 16,306 species are endangered with extinction, 188 more than in 2006 (total of 41,415 species on the Red List). The Red List includes the Sumatran orangutan in the Critically Endangered category and the Bornean orangutan in the Endangered category.

2008 release

The 2008 Red List was released on 6 October 2008, at the IUCN World Conservation Congress in Barcelona, and "has confirmed an extinction crisis, with almost one in four [mammals] at risk of disappearing forever". The study shows at least 1,141 of the 5,487 mammals on Earth are known to be threatened with extinction, and 836 are listed as Data Deficient.

2012 release

The Red List of 2012 was released 19 July 2012 at Rio+20 Earth Summit; nearly 2,000 species were added, with 4 species to the extinct list, 2 to the rediscovered list. The IUCN assessed a total of 63,837 species which revealed 19,817 are threatened with extinction. With 3,947 described as "critically endangered" and 5,766 as "endangered", while more than 10,000 species are listed as "vulnerable". At threat are 41% of amphibian species, 33% of reef-building corals, 30% of conifers, 25% of mammals, and 13% of birds. The IUCN Red List has listed 132 species of plants and animals from India as "Critically Endangered"

Species are classified by the IUCN Red List into nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation.

- Extinct (EX) – No known individuals remaining.
- Extinct in the wild (EW) – Known only to survive in captivity, or as a naturalized population outside its historic range.
- Critically endangered (CR) – Extremely high risk of extinction in the wild.
- Endangered (EN) – High risk of extinction in the wild.
- Vulnerable (VU) – High risk of endangerment in the wild.
- Near threatened (NT) – Likely to become endangered in the near future.
- Least concern (LC) – Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category.
- Data deficient (DD) – Not enough data to make an assessment of its risk of extinction.
- Not evaluated (NE) – Has not yet been evaluated against the criteria.

When discussing the IUCN Red List, the official term "threatened" is a grouping of three categories: Critically Endangered, Endangered, and Vulnerable.

a. **Global 200 Sites (WWF)**

   These comprise a series of eco regions identified by the World Wide Fund for Nature (World Wildlife Fund) as the most biologically distinct parts of the planet and therefore prioritised for conservation.

3.8.1 Eco regions (WWF)

Designating eco regions was the first comparative analysis of biodiversity to cover every major habitat type on the planet. Not all of them therefore can be classed as biodiversity hotspots. They cover relatively large areas of land or water containing characteristic and geographically distinct assemblages of natural communities and species, and are described by WWF as

(a) sharing a large majority of their species and ecological dynamics,

(b) sharing similar environmental conditions, and

(c) interacting ecologically in ways that are critical for their long-term persistence.

Altogether 825 terrestrial eco regions across the globe have been identified, and a set of 426 freshwater eco regions has just been completed. WWF has recently launched an analogous global framework of 229 coast and shelf marine eco regions in collaboration with The Nature Conservancy.

3.8.2 Natural World Heritage Sites (UNESCO)

The United Nations Educational, Scientific and Cultural Organization (UNESCO) criteria for designating natural as opposed to cultural World Heritage sites is that they should contain

1. Superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
2. Outstanding examples of major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

3. Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

The most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

3.8.3 Endemic Bird Areas (Birdlife International)

Devised by Birdlife International, Endemic Bird Areas (EBAs) are regions of the world supporting two or more restricted-range species (secondary EBAs support one or more restricted range species), and are regarded as critical regions for bird conservation.

3.8.4 Biodiversity Hotspots (Conservation International)

For a region to qualify as a Conservation International Biodiversity Hotspot, they have set two strict criteria. The area must contain at least 1500 species of vascular plants as endemics, and it has to have lost at least 70 percent of its original habitat. These areas are guaranteed to lose species if they are not properly conserved. All hotspots contain at least one Global 200 Eco region and all but three contain at least one Endemic Bird Area. 60 percent of Global 200 terrestrial Eco regions and 78 percent of EBAs overlap with hotspots.

3.8.5 Wilderness Areas (Conservation International)

To qualify these must constitute a distinct biogeographic unit or a series of units within a single biome and have minimum areas or 10,000 km square or I million hac. They are therefore larger than any existing protected-areas.

Their original natural vegetation should be at least 70% intact-meaning that no more than 30% has been destroyed or significantly degraded by human activities. In this respect they are the opposite of Biodiversity Hotspots. They should also still maintain intact faunal assemblages of large mammals and birds, especially large, wide-ranging predators.

Finally their human population density should be not more than about 5 inhabitants per km square for the region as a whole once urban areas have been subtracted.

They comprise the tropical humid forest of Amazonia, Congo and New Guinea, the tropical dry forests and grasslands of the Chaco, Miombo-Mopane and Australia savannas, the mixed mountain, temperate rain, and temperate needle leaf forests of the Rocky Mountains, Pacific Northwest, Magellanic areas and the Tasmanian World Heritage Wildlife Area, the northern boreal forests, the wetlands of the Llanos, Pantanal, Banados del Este and Sundarbans, the warm and cold-winter deserts of North America, Patagonia, Sahara, Kalahari-Namib, Arabia, Central Asia and Australia, and the Arctic and Antarctic tundra. However, five of these: Amazonia, the Congo forests, New Guinea, the Miombo-Mopane woodlands of Southern Africa and the North American desert complex of northern Mexico and the south western US are classed as High-Biodiversity Wilderness Areas.

3.8.6 The Alliance for Zero Extinction (AZE) Sites

The AZE is a joint initiative of biodiversity conservation organizations from around the world aiming to prevent extinctions by identifying and safeguarding key sites, each one of which is the last remaining refuge or one or more Endangered or Critically Endangered species.

AZE sites must meet all three of the following criteria to qualify:

Contain at least one Endangered (EN) or Critically Endangered (CR) species, as listed on the IUCN Red List.

Have a definable boundary within which the character of habitats, biological communities, and/or management issues have more in common with each other than they do with those in adjacent areas.

Check Your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

4. Kaziranga National Park is located in ----------.
5. IndiraGandhi wildlife sanctuary and National Park is located in ----------.
6. Buffer zone lies between the core and ----------zone
7. Abbreviation of IUCN is ----------

3.9 LET US SUM UP

In this unit you have studied in detail about the environmental conservations, environmental disruptions and environmental ethics. You have understood the concepts of In-Situ Conservation and Ex-Situ Conservation.

3.10EVALUATION

1. Give the types of environmental disruptions
2. What is known as environmental ethics?
3. What is In-Situ Conservation?
4. What is Ex-Situ Conservation?
5. Give the advantages of Ex-Situ preservation.

UNIT - END ACTIVITIES

- List out the National Sanctuaries and plan to visit it.

POINTS FOR DISCUSSION

Discuss the various environmental problems in India and explain the way of controlling the problem.

ANSWER TO CHECK YOUR PROGRESS

1. Chipko.
2. Buffer.
3. D
4. Assam
5. Tamil Nadu
6. Transition
7. International Union for the Conservation of Nature

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan “Environmental science education” Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P “Environmental Education”, Ram Publishers, Chennai.(2002).
3. Veera Bala Rastogi and Jayaraj “Animal ecology and distribution of animals”, Kedar Nath Ram nath, New Delhi. (1984).
4. Lewis, Geraid E. “A Review of Classroom methodologies for environmental education”, The journal of environmental education, (1982).
5. Lange, Robert R. “Environmental Education Needs Assessment and Evaluation”, Colorado. (1980).

HUMAN POPULATION AND ENVIRONMENT

UNIT –IV

STRUCTURE

4.1 INTRODUCTION

The rapid growth of the world's population over the past one hundred years results from a difference between the rate of birth and the rate of death. The growth in human population around the world affects all people through its impact on the economy and environment.

The current rate of population growth is now a significant burden to human well-being. Understanding the factors which affect population growth patterns can help us plan for the future.

4.2 OBJECTIVES

At the end of this unit you will be able to

- Define the concept of population and overpopulation.
- Explain the characteristics of population.
- Identify the reasons for the population explosion.
- Understand the effect of the rapid growth of the population.
- List out the steps to control population in India.

4.3 CAUSES OF OVERPOPULATION

The following are the causes for overpopulation.

i. Decline in the Death Rate

The fall in death rates that is decline in mortality rate is one fundamental causes of overpopulation. Owing to the advancements in medicine, man has found cures to the previously fatal diseases. The new inventions in medicine have brought in treatments for most of the dreadful diseases. This has resulted in an increase in the life expectancy of individuals. Mortality rate has declined leading to an increase in population.

Owing to modern medications and improved treatments to various illnesses, the overall death rate has gone down. The brighter side of it is that we have been able to fight many diseases

and prevent deaths. On the other hand, the medical boon has brought with it, the curse of overpopulation.

ii. Rise in the Birth Rate

Thanks to the new discoveries in nutritional science, we have been able to bring in increase in the fertility rates of human beings. Medicines of today can boost the reproductive rate in human beings. There are medicines and treatments, which can help in conception. Thus, science has led to an increase in birth rate. This is certainly a reason to be proud and happy but advances in medicine have also become a cause of overpopulation.

iii. Migration

Immigration is a problem in some parts of the world. If the inhabitants of various countries migrate to a particular part of the world and settle over there, the area is bound to suffer from the ill effects of overpopulation. If the rates of emigration from a certain nation do not match the rates of immigration to that country, overpopulation makes its way. The country becomes overly populated. Crowding of immigrants in certain parts of the world, results in an imbalance in the density of population.

iv. Lack of Education

Illiteracy is another important cause of overpopulation. Those lacking education fail to understand the need to prevent excessive growth of population. They are unable to understand the harmful effects that overpopulation has.

They are unaware of the ways to control population. Lack of family planning is commonly seen in the illiterate lot of the world. This is one of the major factors leading to overpopulation. Due to ignorance, they do not take to family planning measures, thus contributing to a rise in population.

Viewing the issue of increasing population optimistically, one may say that overpopulation means the increase in human resources. The increase in the number of people is the increase in the number of productive hands and creative minds. But we cannot ignore the fact

that the increase in the number producers implies an increase in the number of consumers. Greater number of people requires a greater number of resources.

Not every nation is capable of providing its people with the adequate amount of resources. The ever-increasing population will eventually leave no nation capable of providing its people with the resources they need to thrive. When the environment fails to accommodate the living beings that inhabit it, overpopulation becomes a disaster.

4.4 POPULATION CHARACTERISTICS

The following are the characteristics of population

i. Exponential growth

When a quantity increases by a constant amount per unit time e.g. 1, 3, 5,7 etc. it is called linear growth. But, when it increases by a fixed percentage it is known as exponential growth e.g. 101, 102, 103, 104, or 2, 4, 8, 16, 32 etc. Population growth takes place exponentially and that explains the dramatic increase in global population in the past 150 years.

ii. Doubling time

The time needed for a population to double its size at a constant annual rate is known as doubling time. It is calculated as follows

Td = 70/r
where Td = Doubling time in years
r = annual growth rate
If a nation has 2% annual growth rate, its population will double in 35 years.

iii. Total Fertility Rates (TFR)

It is one of the key measures of a nation's population growth. TFR is defined as the average number of children that would be born to a woman in her lifetime if the age specific birth rates remain constant. The value of TFR varies from 1.9 in developed nations to 4.7 in developing nations. In 1950's the TFR has been 6.1. However, due to changes in cultural and

technological set up of societies and government policies the TFR has come down which is a welcome change.

iv. Infant mortality rate

It is an important parameter affecting future growth of a population. It is the percentage of infants died out of those born in a year. Although this rate has declined in the last 50 years, but the pattern differs widely in developed and developing countries.

v. Zero population growth (ZPG)

When birth plus immigration in a population are just equal to death plus emigration, it is said to be zero population growth.

vi. Male-female ratio

The ratio of boys and girls should be fairly balanced in a society to flourish. However, due to female infanticides and gender-based abortions, the ratio has been upset in many countries including India. In China, the ratio of boys to girls became 140 : 100 in many regions which led to scarcity of brides.

vii. Life expectancy

It is the average age that a new-born infant is expected to attain in a given country. The average life expectancy, over the globe, has risen from 40 to 65.5 years over the past century. In India, life expectancy of males and females was only 22.6 years and 23.3 years, respectively in 1900. In the last 100 years improved medical facilities and technological advancement has increased the life expectancy to 60.3 years and 60.5 years, respectively for the Indian males and females. In Japan and Sweden, life expectancy is quite higher, being 82.1-84.2 for females and 77-77.4 for males, respectively.

viii. Demographic transition

Population growth is usually related to economic development. There occurs a typical fall in death rates and birth rates due to improved living conditions leading to low population

growth, a phenomenon called demographic transition. It is associated with urbanisation and growth and occurs in four phases

(a) Pre-industrial phase characterized by high growth and death rates and net population growth is low.

(b) Transitional phase that occurs with the advent of industrialization providing better hygiene and medical facilities and adequate food, thereby reducing deaths. Birth rates, however, remain high and the population shows 2.5-3% growth rate.

(c) Industrial phase while there is a fall in birth rates thereby lowering growth rate.

(d) Post industrial phase during which zero population growth is achieved.

Demographic transition is already observed in most developing nations. As a result of demographic transition the developed nations are now growing at a rate of about 0.5% with a doubling time of 118 years. However, the matter of concern is that more than 90% of the global population is concentrated in developing nations which have a growth rate a little more than 2%, and a doubling time of less than 35 years.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

1. Lack of education is one of the reason for overpopulation. (Yes/No)

2. When birth plus immigration in a population are just equal to death plus emigration, it is said to be ---------- growth.

3. What is meant by life expectancy?

4. What is doubling time?

4.5 POPULATION EXPLOSION

There has been a dramatic reduction in the doubling time of the global human population, as we have already discussed. In the 20th century, human population has grown much faster than ever before. Between 1950-1990, in just 40 years the population crossed 5 billion marks with current addition of about 92 million every year, or so to say, adding a new Mexico every year. In the year 2000, the world population was 6.3 billion and it is predicted to grow four times in the next 100 years. This unprecedented growth of human population at an alarming rate is referred to as population explosion.

India is the second most populous country of the world with 1 billion people. If the current growth rates continue, it will have 1.63 billion people by 2050 and will become the most populous country surpassing China. So we are heading for very serious ramifications of the population explosion problem.

If we look at the population statistics of our country we find that in just 35 years after independence we added another India in terms of population. On 11th May, 2000 we became 1 billion and now we can say that every 6th person in this world is an Indian.

Population explosion is causing severe resource depletion and environmental degradation. Our resources like land, water, fossil fuels, minerals etc. are limited and due to over exploitation these resources are getting exhausted.

Even many of the renewable resources like forests, grasslands etc. are under tremendous pressure. Industrial and economic growth are raising our quality of life but adding toxic pollutants into the air, water and soil. As a result, the ecological life-support systems are getting jeopardized.

There is a fierce debate on this issue as to whether we should immediately reduce fertility rates through worldwide birth control programs in order to stabilize or even shrink the population or whether human beings will devise new technologies for alternate resources, so that

the problem of crossing the carrying capacity of the earth will never actually come. There are two very important views on population growth which need a mention here.

i. Malthusian theory

According to Malthus, human populations tend to grow at an exponential or compound rate whereas food production increases very slowly or remains stable. Therefore, starvation, poverty, disease, crime and misery are invariably associated with population explosion. He believes “positive checks” like famines, disease outbreak and violence as well as “preventive checks” like birth control stabilize population growth.

ii. Marxian theory

According to Karl Marx, population growth is a symptom rather than the cause of poverty, resource depletion, pollution and other social ills. He believed that social exploitation and oppression of the less privileged people leads to poverty, overcrowding, unemployment, environmental degradation that in turn, causes over population.

A compromise between the two views is required because all these factors seem to be interdependent and interrelated. Equity and social justice to all, allowing everyone to enjoy a good standard of living is the need of the hour that can voluntarily help in achieving a stabilized global population.

4.5.1. Demographic transition

Demographic transition explains a form of relationship between population and economic development. In the western countries it has been found that they have moved from a condition of high birth and death rates, to a condition of low birth and death rates which led to a slow rate of growth of population. This demographic change is known as 'Demographic Transition' in other words, demographic transition describes the passage through which countries move from high birth and death rates to low ones. This has been the experience of countries going through a process of modernizing economic and social development.

The growth rate of population is a function of migration, birth rate and death rate in a country. The change in population caused by net migration as a proportion of total population of the country is almost insignificant and, therefore, can be easily ignored. That leaves us with birth rate and death rate. The difference between the birth rate and the death rate measures the growth rate of population. The high population growth rates are due to high birth rate and fast declining death rates due to better sanitation and health facilities. However, the capacities to absorb increasing manpower are much weaker. Furthermore, the process of economic development tends to be more capital intensive under modern technological conditions, and hence, has less potential of employment generation in the short run. Since the total size of the population is already large, there is urgency for speedy achievement of demographic transition from high birth rate to low birth rate resulting in lower population growth.

Let us list effects of the rapid population growth in India. They are

Providing employment to growing population

This is so because in developing economies majority of the population is illiterate. The burden of school age population has already shown signs of becoming unbearable. The proportion of children in schools is increasing fast and, vast numbers are still not covered. The absolute number or illiterate persons increases every year. This is only an indication of the wastage of human resources for want of appropriate development opportunities.

Problem of utilisation of manpower

Better educated manpower aspires for occupations of greater prestige, which are opened up by the new development efforts. Because of its capital intensive nature, the ability, of the new economy for employment generation becomes restricted. Simultaneously, it renders many of the old occupations out of day and redundant. As a result, under-employment and unemployment, including unemployment of educated persons, increases. There is thus wastage of even developed human capital.

Over-strained infrastructure

Facilities such as housing, transportation, health care, and education become inadequate. The worst symptoms of congestion in every aspect of living conditions are manifested in the urban areas. In countries such as India, a situation of "over urbanisation" prevails which puts unbearable strain on urban amenities. Overcrowded houses, slums and unsanitary localities, traffic congestion and crowded hospitals have become common features in the developing countries.

Pressure on land and other renewable natural resources

Common properties such as forest and water are over-exploited. This results in deforestation and desertification with permanent damage to the renewable resources.

Increased cost of production

Human ingenuity and technological advancement makes it possible to increase production of goods and services. But, it must be kept in mind that, the cost of production of the basic necessities of life, such as food, increases when the population is growing fast and worse lands are brought into cultivation with costly irrigation etc.

Inequitable distribution of income

Both at the international and national levels income disparities increase. The increase in gross national product (GNP) is greatly reduced in per capita terms on account of the rapidly growing population. In the face of a rapidly growing population, the major concern of a developing country tends to be focused more on economic growth as such. Considerations of unequal distribution of income are pushed to background. So inequalities within the country tend to widen further.

Every nook and corner of India is a clear display of increasing population. Whether you are in a metro station, airport, railway station, road, highway, bus stop, hospital, shopping mall, market, temple, or even in a social/ religious gathering, we see all these places are overcrowded at any time of the day. This is a clear indication of overpopulation in the country.

According to the Indian census, carried out in 2011, the population of India was exactly 1,210,193,422, which means India has crossed the 1-billion mark. This is the second most populous country of the world after China and the various studies have projected that India will be world's number-1 populous country, surpassing China, by 2025. In spite of the fact that the population policies, family planning and welfare programmes undertaken by the Govt. of India have led to a continuous decrease in the fertility rate, yet the actual stabilisation of population can take place only by 2050.

Causes of Over Population

The two main common causes leading to over population in India are

- The birth rate is still higher than the death rate. We have been successful in declining the death rates but the same cannot be said for birth rates.
- The fertility rate due to the population policies and other measures has been falling but even then it is much higher compared to other countries.

The above causes are interrelated to the various social issues in our country which are leading to over population.

- **Early Marriage and Universal Marriage System:** Even though legally the minimum age of marriage of a girl is 18 years, the concept of early marriage still prevails and getting married at young age prolongs the child bearing age. Also, in India, marriage is a sacred obligation and a universal practice, where almost every woman is married at the reproductive age.
- **Poverty and Illiteracy:** Another factor for the rapid growth of population is poverty. Impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some feel that more children are needed to look after them in their old age. Also hunger can be cause of death of their children and hence the need for more children. Strange but true, Indian still lag behind the use of contraceptives and birth control methods. Many of them are not willing to discuss or are totally unaware about them. Illiteracy is thus another cause of over population.

- **Age old cultural norm:** Sons are the bread earners of the families in India. This age old thought puts considerable pressure on the parents to produce children till a male child is born.
- **Illegal migration:** Last but not the least; we cannot ignore the fact that illegal migration is continuously taking place from Bangladesh, Nepal leading to increased population density.

4.6 EFFECTS OF OVER POPULATION

Even after 67 years of independence, the scenario of our country is not good, due to over population. Some major impacts of high population are as follows:

- **Unemployment:** Generating employment for a huge population in a country like India is very difficult. The number of illiterate persons increases every year. Unemployment rate is thus showing an increasing trend.
- **Manpower utilisation:** The number of jobless people is on the rise in India due to economic depression and slow business development and expansion activities.
- **Pressure on infrastructure:** Development of infrastructural facilities is unfortunately not keeping pace with the growth of population. The result is lack of transportation, communication, housing, education, healthcare etc. There has been an increase in the number of slums, overcrowded houses, traffic congestion etc.
- **Resource utilisation:** Land areas, water resources, forests are over exploited. There is also scarcity of resources.
- **Decreased production and increased costs:** Food production and distribution have not been able to catch up with the increasing population and hence the costs of production have increased. Inflation is the major consequence of over population.
- **Inequitable income distribution:** In the face of an increasing population, there is an unequal distribution of income and inequalities within the country widen.

4.7 STEPS TO CONTROL POPULATION IN INDIA

The Government of India, politicians, policy makers should initiate a bold population policy so that the economic growth of the country can keep pace with the demands of a growing

population. Major steps which have been already implemented but still need to be emphasised more to control population. Increasing the welfare and status of women and girls, spread of education, increasing awareness for the use of contraceptives and family planning methods, sex education, encouraging male sterilisation and spacing births, free distribution of contraceptives and condoms among the poor, encouraging female empowerment, more health care centres for the poor, to name a few, can play a major role in controlling population.

India's strengths in the global world in various fields cannot be ignored, whether in science & technology, medicine and health care, business and industry, military, communication, entertainment, literature and many more. Experts are hopeful that by increasing public awareness and enlisting strict population control norms by the Government will definitely lead the way for the country's economic prosperity and control of population.

4.8 NATIONAL FAMILY WELFARE PROGRAMME

i. Introduction

India launched the National Family Welfare Programme in 1951 with the objective of "reducing the birth rate to the extent necessary to stabilize the population at a level consistent with the requirement of the National economy. The Family Welfare Programme in India is recognized as a priority area, and is being implemented as a 100% Centrally sponsored programme.

ii. Evolution of family welfare program

The approach under the programme during the First and Second Five Year Plans was mainly "Clinical" under which facilities for provision of services were created. However, on the basis of data brought out by the 1961 census, clinical approach adopted in the first two plans was replaced by "Extension and Education Approach" which envisaged expansion of services facilities along with spread of message of small family norm.

In the IV Plan (1969-74), high priority was accorded to the programme and it was proposed to reduce birth rate from 35 per thousand to 32 per thousand by the end of plan. 16.5 million couples, constituting about 16.5% of the couples in the reproductive age group, were protected against conception by the end of IV Plan.

The objective of the V plan (1974-79) was to bring down the birth rate to 30 per thousand by the end of 1978-79 by increasing integration of family planning services with those of Health,

Maternal and Child Health (MCH) and Nutrition, so that the programme became more readily acceptable. The years 1975-76 and 1976-77 recorded a phenomenal increase in performance of sterilization. However, in view of rigidity in enforcement of targets by field functionaries and an element of coercion in the implementation of the programme in 1976-77 in some areas, the programme received a set-back during 1977-78.

As a result, the Government made it clear that there was no place for force or coercion or compulsion or for pressure of any sort under the programme and the programme had to be implemented as an integral part of "Family Welfare" relying solely on mass education and motivation. The name of the programme was also changed to Family Welfare from Family Planning.

In the VI Plan (1980-85), certain long-term demographic goals of reaching net reproduction rate of unity were envisaged.

The Family Welfare Programme during VII five year plan (1985-90) was continued on a purely voluntary basis with emphasis on promoting spacing methods, securing maximum community participation and promoting maternal and child health care. The Universal Immunization Programme (UIP) was launched in 1985 to provide universal coverage of infants and pregnant women with immunization against identified vaccine preventable diseases and extended to all the districts in the country

The approach adopted during the Seventh Five Year Plan was continued during 1990-92. For effective community participation, Mahila Swasthya Sanghs(MSS) at village level was constituted in 1990-91. MSS consists of 15 persons, 10 representing the varied social segments in the community and five functionaries involved in women's welfare activities at village level such as the Adult Education Instructor, Anganwadi Worker, Primary School Teacher, Mahila Mukhya Sevika and the Dai. Auxiliary Nurse Midwife(ANM) is the Member-Convenor.

From the year 1992-93, the UIP has been strengthened and expanded into the Child Survival and Safe Motherhood (CSSM) Project. It involves sustaining the high immunization coverage level under UIP, and augmenting activities under Oral Rehydration Therapy, prophylaxis for control of blindness in children and control of acute respiratory infections. Under the Safe Motherhood component, training of traditional birth attendants, provision of aseptic delivery kits and strengthening of first referral units to deal with high risk and obstetric emergencies were being taken up.

To impart new dynamism to the Family Welfare Programme, several new initiatives were introduced and ongoing schemes were revamped in the Eighth Plan (1992-97). Realizing that Government efforts alone in propagating and motivating the people for adaptation of small family norm would not be sufficient, greater stress has been laid on the involvement of NGOs to supplement and complement the Government efforts.

Reduction in the population growth rate has been recognized as one of the priority objectives during the Ninth & Tenth Plan period.

iii. The strategies are

i) To assess the needs for reproductive and child health at PHC level and undertake area specific micro planning.

ii) To provide need-based, demand-driven, high quality, integrated reproductive and child health care reducing the infant and maternal morbidity and mortality resulting in a reduction in the desired level of fertility.

iv. Contraceptives

The National Family Welfare Programme provides the following contraceptive services for spacing births

a) Condoms

b) Oral Contraceptive Pill

c) Intra Uterine Devices (IUD)

Whereas condoms and oral contraceptive pills are being provided through free distribution scheme and social marketing scheme, IUD is being provided only under free distribution scheme. Under Social Marketing Programme, contraceptives, both condoms and oral pills are sold at subsidized rates. In addition, contraceptives are commercially sold by manufacturing companies under their brand names also. Govt. of India does not provide any subsidy for the commercial sale.

v. Copper-T

Cu-T is one of the important spacing methods offered under the Family Welfare Programme. Cu-T is supplied free of cost to all the States/UTs by Govt. of India for insertion at the PHCs, Sub-centres and Hospitals by trained Medical Practitioners/trained Health Workers.

The earlier version of Cu-T 200 ‘B’ (IUDs) has been replaced by Cu-T 380-A from 2002-03onwards which provides protection for a longer period(about 10 years) as against Cu-T 200 ‘B’ which provided protection for about 3 years only.

vi. Emergency contraceptive pill

ECP was introduced under Family Welfare Programme during 2002-03. The emergency contraceptive is the method that can be used to prevent unwanted pregnancy after an unprotected act of sexual intercourse (including sexual assault, rape or sexual coercion) or in contraceptive failure. Emergency Contraceptive is to be taken on prescription of Medical Practitioners.

vii. Terminal methods

Under National Family Welfare Programme following Terminal/ Permanent Methods are being provided to the eligible couples.

A) TUBECTOMY

i) Mini Lap Tubectomy

ii) LaproTubectomy

Laparoscopic sterilization is a relatively quicker method of female sterilization.

B) VASECTOMY

i) Conventional Vasectomy

ii) No-Scalpel Vasectomy

It is one of the most effective contraceptive methods available for males. It is an improvement on the conventional vasectomy with practically no side effects or complications. This new method is now being offered to men who have completed their families. The No-Scalpel Vasectomy project is being implemented in the country to help men adopt male sterilization and thus promote male participation in the Family Welfare programme.

4.9 FACTORS AFFECTING ENVIRONMENT

From the immense amount of propaganda that goes around in the media these days, it is clear that there is a lot of environmental degradation all around us. Such is the depth of the

situation that conferences are being held every year, and new tools like CDM (Clean Development Mechanism) and Carbon credits are being created to prevent further damage and to encourage protection of the environment.

Top ten factors for The Environmental Damage

1) High quantity of Exhaust gases: The biggest reason for all kinds of environmental degradation is the exorbitant amount of gases, harmful to the environment, which is released by the various industries. Prime amongst these gases are C02, S02 and NH3. Of course there are many more, and these are the main culprits for ozone holes and global warming.

2) Deforestation: Deforestation causes major problems for one simple reason; it decreases the number of trees, which clean the environment, provide oxygen and also affect rain patterns.

3) High number of industries such as mining: Mining creates a lot of pollution, mainly because it releases particulate matter, which qualifies as Respirable Particulate Matter (RPM); the particulate matter which can enter our lungs and can harm the entire respiratory system.

4) Chemical effluents: Effluents are another by-product of industries which poses threat to the environment, leather and tanning industries, petroleum industries and chemical manufacturing industries create major waste products which are released directly into nearby streams without treatment, creating river pollution and causing harm to aquatic life.

5) Transport: Smog is a nuisance that is created because of vehicular pollution, and Hydro-Carbons released from engines are the cause of creation of lower level ozone that is harmful to humans.

6) Unprecedented Construction: Urban Heat Island is a direct cause of the unprecedented construction activities that are being carried out right now, and urban heat island causes trapping of pollutants. Urban Heat island is an effect caused due to trapping of solar radiation by concrete and cement which are materials which trap heat extremely well. Construction causes removal of vegetative cover which usually allows for better exchange of heat. This heat island effect causes

constricted circulation of air, which traps pollutants released in urban areas and does not allow for mixing of the air, thus decreasing the air quality.

7) Secondary Pollutants: Secondary pollutants are ones that are not directly emitted; however they get created when primary pollutants react amongst themselves. Major amongst them is the creation of ozone from reaction between non-burnt Hydrocarbons and Nitrous Oxides.

8) Ruinous agricultural policies: Overloading the land with fertilizers, overgrazing and shifting agriculture are ruinous agricultural policies that degrade land, creating soil erosion that leads to silting in major rivers and reservoirs. Soil degradation is a continuous cycle and it ultimately leads to desertification and degradation of land quality by allowing the direct action of eroding agents on cultivable land.

9) The Population Explosion: The increasing population creates a load that the entire environment has to support, not only in terms of food and lodging, but also in terms of the amount of waste that it generates and the ability of the environment to sustain this growth.

10) Unplanned Land-use policies: Land models are available these days which help in proper planning and use of land resources. However, failure to use these models and land management policies can lead to land pollution and degradation of the worst kind.

4.9.1 Acid rain

It is a rain that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions. It can have harmful effects on plants, aquatic animals and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids. Some Governments have made efforts since the 1970s to reduce the release of sulfur dioxide and nitrogen oxide into the atmosphere with positive results. Nitrogen oxides can also be produced naturally by lightning strikes, and sulfur dioxide is produced by volcanic eruptions. The chemicals in acid rain can cause paint to peel, corrosion of steel structures such as bridges, and weathering of stone buildings and statues.

Natural phenomena

The principal natural phenomena that contribute acid-producing gases to the atmosphere are emissions from volcanoes. Thus, for example, fumaroles from the Laguna Caliente crater of Poás Volcano create extremely high amounts of acid rain and fog, with acidity as high as a pH of 2, clearing an area of any vegetation and frequently causing irritation to the eyes and lungs of inhabitants in nearby settlements.

Human activity

The principal cause of acid rain is sulfur and nitrogen compounds from human sources, such as electricity generation, factories, and motor vehicles. Electrical power generation using coal is among the greatest contributors to gaseous pollutions that are responsible for acidic rain. The gases can be carried hundreds of kilometers in the atmosphere before they are converted to acids and deposited. In the past, factories had short funnels to let out smoke but this caused many problems locally; thus, factories now have taller smoke funnels. However, dispersal from these taller stacks causes pollutants to be carried farther, causing widespread ecological damage.

4.9.2 Greenhouse effect

The greenhouse effect is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere. If a planet's atmosphere contains radiatively active gases (i.e., greenhouse gases) the atmosphere will radiate energy in all directions. Part of this radiation is directed towards the surface, warming it. The downward component of this radiation – that is, the strength of the greenhouse effect – will depend on the atmosphere's temperature and on the amount of greenhouse gases that the atmosphere contains.

Earth’s natural greenhouse effect is critical to supporting life. Human activities, primarily the burning of fossil fuels and clearing of forests, have intensified the natural greenhouse effect, causing global warming. The mechanism is named after a faulty analogy with the effect of solar radiation passing through glass and warming a greenhouse. The way a

greenhouse retains heat is fundamentally different, as a greenhouse works by reducing airflow and retaining warm air inside the structure.

Green house gases

By their percentage contribution to the greenhouse effect on Earth the four major gases are

- water vapor, 36–70%
- carbon dioxide, 9–26%
- methane, 4–9%
- ozone, 3–7%

It is not physically realistic to assign a specific percentage to each gas because the absorption and emission bands of the gases overlap (hence the ranges given above). The major non-gas contributor to Earth's greenhouse effect, clouds also absorb and emit infrared radiation and thus have an effect on the radioactive properties of the atmosphere.

4.9.3 Extinction species

In ecology, extinction is the end of an organism or of a group of organisms, normally a species. The moment of extinction is generally considered to be the death of the last individual of the species, although the capacity to breed and recover may have been lost before this point.

Species that have become extinct, either in the wild life are completely disappeared from Earth. In practice, a species not definitely located in the wild life in the last 50 years is called extinct.

Soil erosion

Deforestation increases soil erosion; thus valuable agricultural land is lost. Solid wastes from household and industries also pollute land and enhance land degradation. Solid wastes include things from household waste and of industrial wastes. They include ash, glass,

peelings of fruit and vegetables, paper, clothes, plastics, rubber, leather, brick, sand, metal, waste from cattle shed, night soil and cow dung. Chemicals discharged into air, such as compounds of sulfur and lead, eventually come to soil and pollute it. The heaps of solid waste destroy the natural beauty and surroundings become dirty. Pigs, dogs, rats, flies, mosquitoes visit the dumped waste and foul smell comes from the waste. The waste may block the flow of water in the drain, which then becomes the breeding place for mosquitoes. Mosquitoes are carriers of parasites of malaria and dengue. Consumption of polluted water causes many diseases, such as cholera, diarrhea and dysentery.

Energy crises

An energy crisis is any significant bottleneck in the supply of energy resources to an economy. In popular literature, it often refers to one of the energy sources used at a certain time and place, in particular those that supply national electricity grids or those used as fuel in vehicles. Government actions like tax hikes, nationalization of energy companies, and regulation of the energy sector, shift supply and demand of energy away from its economic equilibrium. Market failure is possible when monopoly manipulation of markets occurs. A crisis can develop due to industrial actions like union organized strikes and government embargoes. The cause may be over-consumption, aging infrastructure, choke point disruption or bottlenecks at oil refineries and port facilities that restrict fuel supply. An emergency may emerge during very cold winters due to increased consumption of energy.

Check Your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

5. India is the ---------- most populous country of the world.
6. Population explosion is causing severe resource depletion and environmental -----.
7. Deforestation and desertification are the reasons for permanent damage to the ---------- resources.
8. The difference between the birth rate and the death rate measures the growth rate of population. (right/wrong).

4.10 LET US SUM UP

In this unit you have studied in detail about the population, population explosion, causes for over population, effects of over population and population control. You have learned about the national family welfare programme. You have understood the concepts about the factors affecting environment, and acid rain.

4.11 EVALUATION

1. What are all the causes of over population ?
2. What is called life expectancy ?
3. Explain in detail about demographic transition ?
4. What are all the steps to control population in India ?
5. What is national family welfare programme ?
6. What are all the factors affecting environment ?
7. Explain acid rain.
8. Write a short note on soil erosion.

UNIT - END ACTIVITIES

- Identify the effect of population growth in your local area.

POINTS FOR DISCUSSION

- "Both the industrial development and environmental sustainability are essential"

ANSWER TO CHECK YOUR PROGRESS

1. Yes
2. Zero population
3. It is the average age that a new-born infant is expected to attain in a given country
4. The time needed for a population to double its size at a constant annual rate is known as doubling time.
5. Second.
6. Degradation.

7. Renewable
8. Right

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan “Environmental science education” Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P “Environmental Education”, Ram Publishers, Chennai.(2002).
3. Lewis, Geraid E. “A Review of Classroom methodologies for environmental education”, The journal of environmental education, (1982).
4. Lange, Robert R. “Environmental Education Needs Assessment and Evaluation”, Colorado. (1980).

INTERNATIONAL EFFORTS FOR ENVIRONMENTAL PROTECTION

UNIT-V

STRUCTURE

5.1 INTRODUCTION

Environmental awareness among the public and policy makers has been growing since the 1960s. Research has demonstrated the importance of the environment to human health and well-being. On account of the growing awareness of the environmental crisis today assigned top priority in national and international agenda. In order to develop environmental awareness and to deal with regional and global environmental changes, many international efforts have been initiated. The international efforts like Stockholm conference, the Nairobi conference, the RIO summit, and the Kyoto conference are discussed in this unit.

5.2 OBJECTIVES

At the end of the unit, you will be able to

- Define the environmental awareness
- Understand the declaration of Stockholm conference
- Identify the major principles of Nairobi conference
- Understand the recommendations of RIO summit
- Analyze the importance of Kyoto conference
- Appreciate the international efforts to protect environment

5.3 DEFINITIONS OF ENVIORNMENTAL AWARENESS

Environmental awareness may be defined to help the social groups and individuals to gain a variety of experience in and acquire a basic understanding of environment and its associated problems. Educators and Environmental specialists have repeatedly pointed out that any solution to the environmental crisis will require environmental awareness and understanding to be deeply rooted in the educational system at all levels.

5.4 THE STOCKHOLM CONFERENCE

The Conference in Stockholm was the first time that attention was drawn to the need to preserve natural habitats to produce a sustained improvement in living conditions for all, and the need for international cooperation to achieve this. The emphasis was on solving environmental

problems, but without ignoring social, economic and developmental policy factors. United Nations Environmental agency organized a World Conference on Environment at Stockholm, the capital of Sweden from 5th to 16th June 1972. It was attended by high level representatives of 114 nations and many environmentalists and nature lovers and was presided by Maurice Strong. It was called the "International Conference on Human Environment, 1972". The Indian delegation led by Prime Minister Indira Gandhi while addressing this conference, drew the attention of the world community to our environmental problems. India, along with other developing countries felt that the environmental problems are more due to lack of development rather than excessive development. In that conference 150 action plans, 109 other suggestions and 26 principles were approved for promoting the improvement of environment and protection of the delicate environmental balance.

That same year, the Club of Rome published its report on "The Limits to Growth", which attracted enormous attention in the climate of the Stockholm Conference and the oil crisis of the early 1970s.The Stockholm Declaration that was adopted at the conference was formulated jointly by industrialized and developing countries. It contains principles of environmental protection and development, as well as practical recommendations for their implementation. It may be regarded as one of the foundation stones of the international policy that would come to be known as "sustainable development". The Conference led in the same year to the establishment of the UN Environmental Programme (UNEP), based in Nairobi, Kenya. A global monitoring system, 'Earthwatch', was also set up and has since been integrated into the UNEP.

5.4.1 Stockholm Declaration

Principles of the Stockholm Declaration:

1. Human rights must be asserted.
2. Natural resources must be safeguarded
3. The Earth's capacity to produce renewable resources must be maintained
4. Wildlife must be safeguarded
5. Non-renewable resources must be shared and not exhausted
6. Pollution must not exceed the environment's capacity to clean itself

7. Damaging oceanic pollution must be prevented
8. Development is needed to improve the environment
9. Developing countries therefore need assistance
10. Developing countries need reasonable prices for exports to carry out environmental management
11. Environment policy must not hamper development
12. Developing countries need money to develop environmental safeguards
13. Integrated development planning is needed
14. Rational planning should resolve conflicts between environment and development
15. Human settlements must be planned to eliminate environmental problems
16. Governments should plan their own appropriate population policies
17. National institutions must plan development of states' natural resources
18. Science and technology must be used to improve the environment
19. Environmental education is essential
20. Environmental research must be promoted, particularly in developing countries
21. States may exploit their resources as they wish but must not endanger others
22. Compensation is due to states thus endangered
23. Each nation must establish its own standards
24. There must be cooperation on international issues
25. International organisations should help to improve the environment
26. Weapons of mass destruction must be eliminated

5.4.2 Salient Recommendations of the Stockholm Conference

The salient recommendations of the Stockholm conference are as follows:

i. All possible steps should be taken by States to prevent pollution of the seas by substances that are causing hazards to human health, living resources and marine life.
ii. Introduction of the concept of Sustainable Development, which was given a definite shape in 1987 by the World Commission on Environment and Development in its report, entitled "Our Common Future".

iii. Man can transform his environment in countless ways on an unprecedented scale. The protection and improvement of the human environment promotes the well being of people and economic development throughout the world; it is the urgent desire of the people of the whole world the duty of all governments.

iv. Resources should be made available to preserve and improve the environment.

v. The task of planning, managing or controlling the environmental resources for improving the quality of environment must be entrusted to appropriate national institutions.

vi. Scientific research and development in the context of environmental problems, must be promoted in all countries, especially in developing countries.

vii. In accordance with the provisions of the United Nations Charter and Principles of International Law, States have sovereign rights to exploit their own resources pursuant to their environmental problems.

viii. International matters concerning the protection and improvement of the environment should be handled in a cooperative spirit by all countries through multinational or bilateral agreements or treaties.

The conference helped to evoke environmental consciousness all over the world. Many nations started enacting laws to protect environment. In fact, the rising environmental awareness resulting in the formation of many environmental organizations and groups all over the world and all the environmental protection laws, protocols and covenants are the aftermath of the Stockholm Conference. The conference declared that June 5 to be observed as the World Environment Day every year.

5.5 BRUNDTLAND COMMISSION

In 1983, the World Commission on Environment and Development (WCED) convened by the United Nations was created to address growing concern about the consequences of the accelerating deterioration of the human environment and the natural resources. The outcome of the work by the WCED was the report ‘Our Common Future’.

The report was quickly named the Brundtland Report in recognition of the chairman of the WCED, Gro Harlem Brundtland. The report was published in 1987 and was the first to focus

on global sustainability. It addressed governments, businesses and, above all, people whose welfare should be a key element for environmental and development policies. It provided a comprehensive overview of the major global environmental crisis and suggestions on how to solve these problems. The Brundtland report placed environmental issues firmly on the political agenda with the aim to discuss environment and development as a single and identical issue.

The report gathered different issues related to environmental problems and launched a comprehensive gateway to sustainability, which included social, economic, political-institutional and environmental criteria. The concept of sustainability created by the WCED has since been used and also redeveloped in the ongoing work with sustainability within different spheres. The Brundtland Report, however, has been criticised for toning down the social dimension of sustainability by organizations who have worked to maintain the original holistic idea. Among these are The Wuppertal Institute who further processed the Brundtland report.

The Brundtland Report and the concept of sustainability can be seen as an attempt to create awareness of the disturbing relations between human society and the natural environment, focusing on institutional, economic, ecological and social aspects. Sustainability is, however, not a clear cut homogeneous concept. It is a complex concept, which there is in praxis no consensus about, apart from the overall and quite broad principles. Today, the term is very commonly used but in effect the concept of sustainability is actively re-designed for the specific purpose at any given time and context. Nevertheless, the birth of the Brundtland report sustainability concept has influenced environmental laws and planning in a wide range of countries.

The publication of Our Common Future and the work of the World Commission on Environment and Development laid the groundwork for the convening of the Rio Declaration created at the 1992 Earth Summit, the adaptation of Agenda 21 and the establishment of the UN Commission on Sustainable Development.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

1 ---------- is called the "International Conference on Human Environment, 1972".

2. On which conference declared that June 5 to be observed as the World Environment Day every year.

3. In 1983, the World Commission on Environment and Development (WCED) convened by the United Nations is ----------.

4. The outcome of the work by the Brundtland Commission was the report----------

5.6 RIO CONFERENCE

The United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit, took place in Rio de Janeiro, Brazil, from June 2-14, 1992. It was held twenty years after the United Nations Conference on the Human Environment took place in Stockholm, Sweden. Government officials from 178 countries and between 20,000 and 30,000 individuals from governments, non-governmental organizations, and the media participated in this event to discuss solutions for global problems such as poverty, war, and the growing gap between industrialized and developing countries. The central focus was the question of how to relieve the global environmental system through the introduction to the paradigm of sustainable development. This concept emphasizes that economic and social progress depends critically on the preservation of the natural resource base with effective measures to prevent environmental degradation.

5.6.1 Rio Declaration at the earth charter

The Rio Declaration on Environment and Development is a set of 27 legally non-binding principles designed to commit governments to ensure environmental protection and responsible development and intended to be an Environmental Bill of Rights, defining the rights of people to development, and their responsibilities to safeguard the common environment. It established the "Precautionary principle" and the principle of "common but differentiated responsibilities". The Declaration recognizes that the only way to have long-term social and economic progress is to link it with environmental protection and to establish equitable global partnerships between governments and key actors of civil society and the business sector.

The Declaration includes many progressive approaches such as the polluter pays principle (the polluter bears the costs of pollution) and the precautionary principle (carry out environmental assessments to identify adverse impacts and eliminate any potential harms from a project before it is started). It advocates that today's development shall not undermine the resource base of future generations and that developed countries bear a special responsibility due to the pressure their societies place on the global environment and the technologies and financial resources they command. Strong environmental policies are inevitable but should not be used as an unjustifiable means of restricting international trade and shutting off the Northern markets for Southern countries. However, nations shall eradicate unsustainable patterns of production and consumption.

The earlier title "Earth Charter" was later appropriately downgraded as its contents were watered down and negotiated away. Effectively, its 27 principles are almost all weaker than the equivalent document signed in Stockholm 20 years earlier. The original idea of establishing an Earth Charter has not been forgotten but taken forward by the independent NGO body, the Earth Charter Initiative.

In order to evolve a common and concerted approach towards environmental problems raised at the Rio Summit, pre-summit deliberations were held at Kualalampur and Nairobi. It was evident from such discussions that battle lines have been drawn between rich nations of the

north and the impoverished nations of the south. The major six basic issue on which the divide was conspicuous are as follows:

1. **Greenhouse Gas Emission:** The rich nations of the north wanted 20% reduction in emission of greenhouse gases like CO_2, CHn by the year 2005. They also wanted a major shift from the use of coal and wood for energy. The poor developing and under-developed countries blamed, the developed countries for large scale emissions of CO_2 and CHn over the past 50 years and hence wanted the latter to make drastic reductions by them would adversely affect their development.
2. **Forests:** The rich countries considered forests in terms of timber, paper and CO_2 links and wanted a legally binding convention that severely restricts the felling of trees especially in tropical rain forests which are rich in biodiversity. But the poorer countries see the forest as community resources in terms of fodder and fuel wood. The moves of the rich would impinge on national sovereignty. The poor nations wanted the north to compensate for conservation and share the profits if the biodiversity is used for research.
3. **Population:** The developed countries think that poverty and population growth are the main reasons for deforestation and water pollution. They want severe steps to control them. The developing countries blame the rich for over consumption. They feel that over-exploitation of resources to feed the industrial development of the west is the major cause of deforestation.
4. **Technology Transfer:** North believes that the technology of development is to be treated as a commercial proposition and those who want it should pay for it. Since most of the pollution is caused by the industrially advanced countries, the South wants the use of technology for cleaning up the pollutants and for improving energy efficiency to be transferred free.
5. **Finance:** The rich does not want to give any mandatory contribution and wants the UN institutions such as the Global Environmental Facility (GEF) or the World Bank to distribute the aid. The South wants firm commitment on aid for environmental actions as the common environment is brutally exploited by the industrialized north.
6. **Degradation:** The developed countries admit that the degradation of environment is due to rapid rate of industrialization, but do not want to pay for it. The developing countries

strongly believe that the north is responsible for all the muck in the past and, therefore, should pay for the cleaning up process. The main stumbling blocks at the Earth Summit were the sharp differences between the U.S. and the third world countries on the issue of owning the responsibility and agreeing to pay for the cleaning-up. The U.S. President declared at the Summit that though he would not sign the bio-diversity treaty, the U.S. will continue to support the cause. The Earth Summit finally ended on June 14, 1992, after adopting the Rio Declaration and Agenda 21. The latter is considered to be a blue print for sustainable development. The Agenda 21 document covered a wide variety of conservation issues and management of resources for development so that the future needs for resources were taken care of. The atmosphere, land resources, forests, mountains, sustainable agriculture and rural development, drought, biological diversity, seas and oceans, freshwater and waste management were among the subjects that were covered with.

5.6.2 Principles of Rio Conference

The Rio Declaration is a framework document which is made up of 27 principles; not legally binding similar to the Stockholm declaration adopted 20 years ago. These Principles are as follows:

Principle 1: Human beings, being at the centre of concerns for sustainable development, are entitled to a healthy and productive life in harmony with nature.

Principle 2: States have the sovereign right to exploit their own resources with their own environmental and developmental policies. They have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or of areas beyond the limits of national jurisdiction.

Principle 3: The right to development must be fulfilled so as to equitably meet development and environmental needs of present and future generations.

Principle 4: In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it.

Principle 5: All states and all people should get involved in eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and betterment the needs of the majority of the people of the world.

Principle 6: The special situation and needs of developing countries, particularly the least developed and those most environmentally vulnerable, should be given special priority. International actions on environment and development should address the interests and needs of all countries.

Principle 7: States should co-operate to conserve, protect and restore the health and integrity of the earth's eco system. The developed countries acknowledge the responsibility that they bear in the pursuit of sustainable development in view of the pressures their societies place on the environment and of the technologies and financial resources they command.

Principle 8: To achieve sustainable development and a higher quality of life for all people, states should reduce and eliminate sustainable patterns of production and consumption and promote appropriate demographic policies.

Principle 9: States should co-operate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchange of scientific and technological knowledge, and by enhancing the development, adoption, diffusion and transfer of technologies, including new and innovative technologies.

Principle 10: Environmental issues are best handled with the participation of all concerned citizen, at the relevant level. At the national level, each individual should have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their

communities, and the opportunity to participate in decision-making processes. States should facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, should be provided.

Principle 11: States should enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular, developing countries.

Principle 12: States should co-operate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of environmental degradation. Trade policy measures for environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing transboundary or global environmental problems should, as far as possible, be based on an international consensus.

Principle 13: States should develop national laws regarding liability and compensation for the victims of population and other environmental damage. States should also co-operate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Principle 14: States should effectively co-operate to discourage or prevent the relocation and transfer to other states of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.

Principle 15: In order to protect the environment, the precautionary approach should be widely applied by states. Where there are treats of serious or irreversible damage, lack of

full scientific certainty should not be used as a reason for postponing cost effective measures to prevent environmental degradation.

Principle 16: National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter-should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

Principle 17: Environmental impact assessment, as a national instrument, should be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to decision of a competent national authority.

Principle 18: States should immediately notify other states of any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment of those states. Every effort should be made by the international community to help states so afflicted.

Principle 19: States should provide prior and timely notification and relevant information to potentially affected states on activities that may have a significant adverse transboundary environmental effect and should consult with those states at an early stage and in good faith.

Principle 20: Women have a vital role in environmental management and development. Their full participation is, therefore essential to achieve sustainable development.

Principle 21: The creativity, ideals and courage of the youth should be mobilized to forge a global partnership in order to achieve sustainable development and ensure a better future for all.

Principle 22: Indigenous people and their communities, and other local communities, have a vital role in environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their

identity, culture and interest and enable their effective participation in the achievement of sustainable development.

Principle 23: The environment and natural resources of people under oppression, and domination and occupation should be protected.

Principle 24: Warfare is inherently destructive of sustainable development. States should, therefore, respect international law providing protection for the environment in times of armed conflict and co-operate in its further development, as necessary.

Principle 25: Peace, development and environmental protection are interdependent and indivisible.

Principle 26: States should resolve all their environmental disputes peacefully and by appropriate means in accordance with the Charter of the United Nations.

Principle 27: States and people should co-operate in good faith and in a spirit of partnership in the fulfillment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development.

5.6.3 Major Achievements of Rio Summit

The major achievements of the Earth Summit can be found in the following documents:

- **The Rio Declaration of Environment and Development**: This document contains a series of principles that define the rights and responsibilities of States in this area.
- **Agenda 21**: This document is a comprehensive blueprint for global actions to effect the transition to sustainable development.
- **Forest Principles**: This document features a set of principles to support the sustainable management or forests worldwide.
- **Two Legally Binding Conventions**: These are the Convention on Climate Change and the Convention on Biodiversity, which are aimed at preventing global climate change and the eradication or biologically diverse species. These conventions were signed by the representatives of more than 150 countries.

5.6.4 Main features of the Rio Declaration

The 1992 Rio Declaration on Environment and Development defines the rights of the people to be involved in the development of their economies, and the responsibilities of human beings to safeguard the common environment. The declaration builds upon the basic ideas concerning the attitudes of individuals and nations towards the environment and development, first identified at the United Nations Conference on the Human Environment (1972).

The Rio Declaration states that long term economic progress is only ensured if it is linked with the protection of the environment. If this is to be achieved, then nations must establish a new global partnership involving governments, their people and the key sectors of society. Together human society must assemble international agreements that protect the global environment with responsible development.

5.7 KYOTO CONFERENCE AND PART ON GLOBAL WARMING (1997)

Kyoto Protocol**,** in full Kyoto Protocol to the United Nations Framework Convention on Climate Change, international treaty, named for the Japanese city in which it was adopted in December 1997 that aimed to reduce the emission of gases that contribute to global warming. In force since 2005, the protocol called for reducing the emission of six greenhouse gases in 41 countries plus the European union to 5.2 percent below 1990 levels during the “commitment period” 2008–12. It was widely hailed as the most significant environmental treaty ever negotiated, though some critics questioned its effectiveness.

The **Kyoto Protocol** is an international treaty, which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits State Parties to reduce greenhouse gases emissions, based on the premise that (a) global warming exists and (b) man-made CO_2 emissions have caused it. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. There are currently 192 Parties to the Protocol.

The Kyoto Protocol implemented the objective of the UNFCCC to fight global warming by reducing greenhouse gas concentrations in the atmosphere to "a level that would

prevent dangerous anthropogenic interference with the climate system" (Art. 2). The Protocol is based on the principle of common but differentiated responsibilities: it puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.

5.8 PRESENT DEVELOPMENTS

The Protocol's first commitment period started in 2008 and ended in 2012. A second commitment period was agreed on in 2012, known as the Doha Amendment to the protocol, in which 37 countries have binding targets: Australia, the European Union (and its 28 member states), Belarus, Iceland, Kazakhstan, Liechtenstien, Norway, Switzerland, and Ukraine. Belarus, Kazakhstan and Ukraine have stated that they may withdraw from the Protocol or not put into legal force the Amendment with second round targets. Japan, New Zealand and Russia have participated in Kyoto's first-round but have not taken on new targets in the second commitment period. Other developed countries without second-round targets are Canada (which withdrew from the Kyoto Protocol in 2012) and the United States (which has not ratified the Protocol). As of November 2015, 55 states have accepted the Doha Amendment, while entry into force requires the acceptances of 144 states.

Negotiations were held in Lima in 2014 to agree on a post-Kyoto legal framework that would obligate all major polluters to pay for CO_2 emissions. China, India and the United States have all signaled that they will not ratify any treaty that will commit them legally to reduce CO_2 emissions.

At the 18th Conference of the Parties (COP18), held in Doha, Qatar in 2012, delegates agreed to extend the Kyoto Protocol until 2020. They also reaffirmed their pledge from COP17, which had been held in Durban, South Africa, in 2011, to create a new, comprehensive, legally binding climate treaty by 2015 that would require greenhouse-gas-producing countries—including major carbon emitters not abiding by the Kyoto Protocol (such as China, India and the United States)—to limit and reduce their emissions of carbon dioxide and other greenhouse gases. The new treaty, planned for implementation in 2020, would fully replace the Kyoto Protocol.

After a series of conferences mired in disagreements, delegates at the COP21, held in Paris, France, in 2015, signed a global but nonbinding agreement to limit the increase of the world's average temperature to no more than 2 °C (3.6 °F) above preindustrial levels while at the same time striving to keep this increase to 1.5 °C (2.7 °F) above preindustrial levels. The landmark accord, signed by all 196 signatories of the UNFCCC, effectively replaced the Kyoto Protocol. It also mandated a progress review every five years and the development of a fund containing $100 billion by 2020—which would be replenished annually—to help developing countries adopt non-greenhouse-gas-producing technologies.

Check Your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

5 The United Nations Conference on Environment and Development (UNCED), also known as the ---------- took place in Rio de Janeiro, Brazil, from June 2-14, 1992.

6 27 Principles were declared in ----------

7 In Kyoto conference, it was adopted in December 1997 that aimed to reduce the emission of gases that contribute to ----------.

8 Doha Amendment is held in the year ----------.

5.9 LET US SUM UP

In this unit you have learnt in detail about the Stockholm conference – 1972, the Nairobi conference – 1982, the RIO Summit – 1992, the Kyoto conference – 1997and the Doha Amendment – 2012. Thus an international convention is essential to protect environment which is intended to build an international consensus that a particular ecological, wildlife or pollution problems exists.

5.10 EVALUATION

1. What is environmental awareness ?

2. Give the principles of Stockholm declaration.

3. What is Brundtland commission ?

4. Explain in detail about Rio declaration.

5. What is global warming ?

5.11 UNIT END ACTIVITIES

Make a comparative study about the Stockholm conference recommendations and RIO summit recommendations in the light of environmental issues.

POINTS FOR DISCUSSION

* Discuss the 27 principles that are adopted by the RIO summit.
* Discuss the report of the Nairobi conference.

ANSWER TO CHECK YOUR PROGRESS

1. World Conference on Environment at Stockholm.

2. Stockholm Conference.

3. Brundtland Commission.

4. 'Our Common Future'.
5. Earth summit.
6. Rio Conference.
7. Global warming.
8. 2012.

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan "Environmental science education" Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P "Environmental Education", Ram Publishers, Chennai.(2002).

3. Lewis, Geraid E. “A Review of Classroom methodologies for environmental education”, The journal of environmental education, (1982).
4. Lange, Robert R. “Environmental Education Needs Assessment and Evaluation”, Colorado. (1980).

ENVIRONMENTAL LAWS IN INDIA

UNIT VI

STRUCTURE

6.1 INTRODUCTION

India has unique environmental heritage. Our country represents almost all types of habits of the world and the land mass of the country and its water bodies sustain our extremely rich variety of living organisms. It is rich in biodiversity which provides various resources for people. Nineteen percent of the land area of India is under forest cover. But the purpose of deforestation, indiscriminate killing of wild animals leads to instance utilization of natural resources and polluting and energy intensive industrial technology along with population explosion and poverty resulted in the depletion of environmental assets. Hence, there is an urgent need to conserve these environmental assets. The Government of India made many attempts to conserve these environmental assets through the act and various policies. In the previous unit you have learnt about the environmental, hazards. In this unit we discuss about various environmental issues in India and policies that are adopted by the government.

6.2 OBJECTIVES

At the end of the unit, you will be able to

- Identify the environmental problems in India.
- Understand the environmental policies in India.
- Understand the environmental legislations in India.
- Appropriate the environmental movements in India.
- Analyse the objectives of chipko movement.
- Recognize the importance of Narmadha valley movement.

6.3 ENVIRONMENTAL POLICY AND LEGISLATIONS IN INDIA

A policy is a broad guideline for planners and administrators. It lays down the general objectives and its execution is left to the administrators. Policy formulation becomes indispensable because policy is an instrument of transformation of a given environment into a preferred environment. It is through a policy that we can precisely identify the problems; fix priority to form alternative approaches and solutions; make a choice among alternatives on the basis of comprehensive analysis if benefits and costs; articulate the choice in terms of goals expressed; provide organization, personnel and resources to ensure effective implementation; and to lay down a mechanism for continuous monitoring of the policy.

In India, attention has been paid right from the ancient times to the present age in the field of environmental protection and improvement. Historically speaking, the laws relating to environment improvement were simple but quite effective and people were aware of the necessity of environmental protection. The present day legislations in India are the outcome of the growing industrialization and population pressure. There are stated to be over 500 Central and State statues which have at least some concern with environmental protection, either directly or indirectly. Besides that, the common law and Constitutional remedies relating to environmental protection are also there.

6.3.1 Policy and Laws in Ancient India

In ancient India, protection and cleaning up of environment was the essence of Vedic culture. The conservation of environment formed an ardent article of faith, reflected in the daily lives of the people and also enshrined in myth folklore, art, culture and religion. In Hindu theology forests, trees and wildlife protection held a place of special reverence. Cutting green trees was prohibited and punishment was prescribed for such acts. Yagyavalkya Smriti and Charak Samhita give many instructions for the use of water for maintaining its purity. Under the Arthashastra, various punishments were prescribed for cutting trees, damaging forests, and for killing animals. The State assumed the functions of maintenance of forests, regulation of forest produce, protection of wildlife, causing pollution and un-civic sanitation. The environmental ethics of nature conservation were not only applicable to common man but the rulers and kings were also bound by them.

6.3.2 Policy and Laws in Medieval India

During the Moghul period environment conservation did not receive much attention. It is rightly said: “To Moghul rulers, forest meant no more than woodlands where they could hunt. To their governors, the forests were properties which yielded some revenue. Barring royal trees, which enjoyed patronage from being cut except upon a fee, there was no restriction on cutting of other trees”. Further, the religious policy of Akbar based on the principal of complete tolerance also reflects concern for protection of birds and beasts in so much so as endeavors were taken during his region to stop their unnecessary killing. During medieval era, another set of

legal principles were inducted, governed by the holy Koran which declares that “we made from water every living things”.

6.3.3 Policy and Laws in British India

With the establishment of British Colonial rule, many changes were brought in the religiously oriented indigenous system. In the field of forest protection, the enactment of the Forest Act, 1865 was the first step at asserting the State monopoly right over the forests. The customary rights of rural communities to manage forests were curtailed by the Act. The Forest Act of 1927 specifically denied people any rights over the forest produce simply because they were domiciled there. In the field of wildlife protection, the British practiced selective wildlife conservation. During this period, the concern for protection and management of water resources in India came through the first major development in the form of Bengal Regulation VI of 1819, which did not mention protection of water environment from pollution but invested the Government with sovereignty over water resources. It marked radical shift from earlier practices, which treated the water resources as “common property” of all, with control lying in the hands of the people. The Shore Nuisance (Bombay and Kolaba) Act of 1853 and the Oriental Gas Company Act of 1857 imposed restrictions on the fouling of water. The Merchant Shipping Act of 1858 dealt with prevention of pollution of sea by oil. In 1860, for the first time, an attempt was made to control especially water and atmospheric pollution through criminal sanctions under the Indian Penal Code, 1860. As against prohibitive provisions under the IPC, 1860, the Easement Act of 1882 allowed a prescription right to pollute the water but it was not an absolute right (one was not to “unreasonably pollute” or cause “material injury to other”). The Bengal Smoke Nuisance Act of 1905 and Bombay Smoke Nuisance Act of 1912 were the earlier laws enacted during the British Raj, aimed at controlling air pollution. Thus, the environmental policy during the British rule was not directed at the conservation of nature but rather was directed at the appropriation and exploitation of common resources with a primary objective of earning revenue. Further, these laws had a narrow scope and limited territorial reach.

6.3.4 Policy and Laws after Independence

The Indian Constitution, as adopted in 1950, did not deal with the subject of environment or prevention and control of pollution as such (until 1976 Amendment). The original text of the Constitution under Article 372(1) has incorporated the earlier existing laws

into the present legal system and provides that notwithstanding the repeal by this Constitution of enactments referred to in Article 395, but subject to other provisions of the Constitution, all laws in force immediately before the commencement of the Constitution shall remain in force until altered, repealed or amended by a competent legislature or other competent authority. As a result, even after five decades of independence, the plethora of such laws is still in operation without any significant change in them. The post-independence era, until 1970, did not see much legislative activity in the field of environmental protection. Meanwhile concern arose over, inter-alia, population increase, greater pollution levels; human impact on animal populations and natural landscapes and other aspects of resource depletion. It was the Stockholm Declaration of 1972 which turned the attention of the Indian Government to the boarder perspective of environmental protection. The government made its stand well known through five year plans as well as the legislations enacted subsequently to curb and control environmental pollution. After 1970, comprehensive (special) environmental laws were enacted by the Central Government in India.

The Wildlife (Protection) Act, 1972, aimed at rational and modern wild life management. The Water (Prevention and Control of Pollution) Act, 1974, provides for the establishment of pollution control boards at Centre and States to act as watchdogs for prevention and control of pollution. The Forest (Conservation) Act, 1980 aimed to check deforestation, diversion of forest land for non-forestry purposes, and to promote social forestry. The Air (Prevention and Control of Pollution) Act,1981, aimed at checking air pollution via pollution control boards. The Environment (Protection) Act, 1986 is a landmark legislation which provides for single focus in the country for protection of environment and aims at plugging the loopholes in existing legislation. It provides mainly for pollution control, with stringent penalties for violations. The Public Liability Insurance Act, 1991, provides for mandatory insurance for the purpose of providing immediate relief to person affected by accidents occurring while handling any hazardous substance. The National Environment Tribunals Act, 1995, was formulated in view of the fact that civil courts litigations take a long time (as happened in Bhopal case). The Act provides for speedy disposal of environmental related cases through environmental tribunals. Under the Act, four benches of the tribunal will be set up in Delhi, Calcutta, Madras and Bombay and 8,000 of the most Hazardous industrial units in the country will be brought under its security.

The National Environment Appellate Authority Act, 1997, provides for the establishment of a National Environment Appellant Authority (NEAA) to hear appeals with respect to restriction in areas in which any industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards under the Environment (Protection) Act, 1986. The Biological Diversity Act, 2002, is a major legislation intervention effected in the name of the communities supposed to be involved in the protection of biodiversity around them. The Act intends to facilitate access to genetic materials while protecting the traditional knowledge associated with them.

6.3.5 Recent Legislative Measures (Delegated Legislation)

During the nineties, some steps have been taken by the Central Ministry of Environment to provide legal and institutional basis for management and protection of environment by way of rules, notification of standards, delegation of powers, identification of agencies for hazardous chemicals management and setting up of Environmental Councils in some States. A new chapter regulating hazardous industrial processes was introduced into the Factories Act. In the area of delegated legislation, effluent and emission standards were specified for 24 industries and general standards for effluent discharge and for noise pollution have been prescribed under the Environment Act. For the analysis of water and air samples, about seventy environmental laboratories were established across the country. Rules for the manufacture and transport of hazardous substances and micro organisms and for the management of toxic wastes were issued. Coastal Zone Regulations (CZR) were issued in 1991. A Gazette notification on environmental audit has been issued, whereby environment audit has been made compulsory for all industries requiring environmental clearance under the Water Act, 1974 or The Air Act, 1981, etc., Further, in 1996, the Central Government framed the Chemical Accidents (Emergency, Planning, Preparedness and Response) Rules to Supplement the Hazardous Chemical Rules of 1989. In 1998, the Central Government issued the Bio-Medical Waste (Management and Handling) Rules to regulate bio-medical waste.

The Central Ministry of Environment issued a notification in 1994 making Environment Impact Assessment statutory for 29 different activities in industries, mining, irrigation, power, etc. A new dimension was added in 1997, to the Environment Impact process in India, by an amendment. The State Pollution Control Boards had nothing to do in the

assessment process so far. They were now given a new role to play. Further, in the case of certain categories of thermal power plants, responsibility of environmental clearance is now conferred on the State Government. Further, the Central Government enacted the Prevention and Control of Pollution (Uniform Consent Procedure) Rules, 1999, requiring all industries listed in Schedule VIII of the Environment Act, 1986 to obtain consent from the State Board or the Pollution Control Committee. The Rules prohibit vendors of foodstuffs from packing their wares in bags or containers made from recycled plastics. If foodstuffs are to be sold in plastic bags, the carry bag must be made of virgin plastic.

The Municipal Solid Wastes (Management and Handling) Rules, 2000, apply to every municipal authority responsible for collection, segregations, storage, transportation, processing and disposal of municipal solid wastes. While the nodal responsibility to enforce these rules lies on the municipality, the Secretary-in-charge of the Dept. of Urban Development of the concerned State, the District Magistrate/Deputy Commissioner shall have the overall responsibility. The Central/ State Pollution Control Boards have been made responsibility to monitor the compliance of the standards regarding ground water, ambient air quality and the compost quality.

In 2000, the Noise Pollution (Regulation and Control) Rules, framed by the Central Government under the Environment Protection Act, 1986, came into effect. These Rules prescribed ambient air quality standards in respect of noise for industrial, commercial and residential areas as well as designated “silence zones”.

In the same year, the Central Government enacted the Ozone Depleting Substances (Regulation and Control), rules, 2000 under the Environment Protection Act. The producers, dealers, users engaged in the manufacture/use of ozone depleting substances such as CFCs, , Carbon tetra chloride (CCI4), etc., are required to compulsorily register under the Rules.

Thus, in recent decades India employed a range of regulatory instruments to preserve and protect its natural resources. These “new” laws are impressive in their range covering hitherto unregulated fields, such as noise, hazardous waste, hazardous micro-organisms, environment impact assessment, etc. the new legislation has spawned new enforcement agencies and strengthened the older ones.

6.3.6 General Legislations on Environment

In India, there are a number of laws which deal with various aspects of environment protection regulation, conduct of environmentally harmful activities and provide for remedies in case of their breach. Some of them are "general" having an "indirect" bearing on environment protection, while others are "special" (viz. Water, Air and Environmental Acts, Forest Act, etc.) being "directly" concerned with environment protection. General legislation comprises of Indian Penal Code, 1860; Code of Criminal Procedure, 1973; Code of Civil Procedure, 1908; and, specific sector legislations having a bearing on the environmental aspects viz.

The Factories Act, 1948, The Mines Act, 1952, The Industries (Development and Regulation) Act, 1951, The Insecticides Act, 1968, The Atomic Energy Act, 1962, The Motor Vehicles Act, 1939 and 1988, The Delhi Municipal Corporation Act, 1957, etc. Under Indian law, for instance, the remedies for a public nuisance are (i) a criminal prosecution for the offence of causing a public nuisance (Indian Penal Code 1860, Sec. 268), (ii) a criminal proceeding before a Magistrate for removing a public nuisance (Criminal Procedure Code 1973, Sections. 133-44), and (iii) a civil action by Advocate General or by two or more members of the public with the permission of the court, for a declaration, an injunction or both (Civil Procedure Code 1908, Section. 91).

The remedy under the civil law is not often used; however this provision is a reservoir for class action against environmental violations. Traditionally, the interpretation of the Indian Penal Code has been viewed as a conservative attempt at enforcement. This is because punishment and fines have been characterized as meager. The law of public nuisance contained in Sec. 133, Cr. P.C. has been used in a number of cases for the purpose of protection of the environment.

In 1987, shortly after the Bhopal gas tragedy and the Supreme Court's ruling in the *Shriram Gas Leak Case*2, the 1987 amendment to the Factories Act introduced special provisions on hazardous industrial activities. The amendment empowers the States to appoint "site appraisal committees" to advice on the initial location of factories using hazardous processes. The occupier of every hazardous unit must disclose to her workers the Factory Inspector the local authority and the general public in the vicinity of all particulars regarding health hazards at the factory, and the preventive measures taken. The regulation of nuclear energy and radioactive substances in India is governed by the Atomic Energy Act of 1962, and

the Radiation Protection Rules of 1971. Under the Act, the Central Government is required to prevent radiation hazards, guarantee public safety and the safety of workers handling radioactive substances, and ensure the disposal of radioactive wastes. The control of air pollution resulting from the vehicular emissions which contributes for about 65-70 per cent of the pollution load in India was taken care of by the Motor Vehicles Act, 1939. The Act empowered the State Government to make rules inter-alia regarding the emission of smoke, visible vapour, sparks, ashes, girt or oil. The 1939 Act has now been repealed by the Motor Vehicles Act, 1988. Section 110 of the new Act empowers the Central Government to make rules regulating the construction equipment and maintenance of motor vehicles and trailers.

In the Constitution of India it is clearly stated that it is the duty of the state 'to *protect and improve the environment and to safeguard the forests and wildlife of the country'*. It imposes a duty on every citizen 'to protect and improve the natural environment including forests, lakes, rivers and wildlife'. Reference to the environment has also been made in the Directive Principles of State Policy as well as the Fundamental Rights. The Department of Environment was established in India in 1980 to ensure a healthy environment for the country. This later became the Ministry of Environment and Forests in 1985. The constitutional provisions are backed by a number of laws – acts, rules and notifications. The Environment Protection Act of 1986(EPA) came into force soon after the Bhopal Gas Tragedy and is considered an umbrella legislation as it fills many gaps in the existing laws. Thereafter a large number of laws came into existence as the problems began arising e.g. Handling and Management of Hazardous Waste Rules in 1989. Following is a list of the environmental legislations that have come into effect.

General

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

1986 – The Environment (Protection) Rules lays down procedures for setting standards of emission or discharge of environmental pollutants.

1989 – Hazardous waste (Management and Handling) Rules objective is to control generation, collection, treatment, import, storage and handling of hazardous waste.

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

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

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

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

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

1998 – Biomedical waste (Management and Handling) Rules is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection and treatment.

Forest and wildlife

1927 – Indian Forest Act and Amendment 1984 is one of the many surviving colonial statutes. It was enacted to 'consolidate the law related to forest, the transit of forest produce and the duty leviable on timber and other forest produce.

1972 – Wildlife Protection Act, Rules 1973 and Amendment 1991 provides for the protection of birds and animals and for all matters that are connected to it whether it be their habitat or the waterhole or the forest that sustain them.

1980 – The Forest (Conservation) Act and Rules 1981 provides for the protection of and the conservation of the forests.

Water

1882 – The Easement Act allows private rights to use a resource i.e. groundwater, by viewing it as an attachment to the land. It also states that all surface water belongs to the state and is a state property.

1897– Indian Fisheries Act establishes two sets of penal offences whereby the government can sue any person who uses dynamite or other explosive substance in any way (whether coastal or inland) with intent to catch or destroy any fish or poisons fish in order to kill.

1956 – The River Boards Act enables the states to enroll the Central Government in setting up an Advisory River Board to resolve issues in interstate cooperation.

1970 – Merchant Shipping Act aims to deal with waste arising from ships along the coastal areas within a specified radius.

1974 – The Water (Prevention and Control of Pollution) Act establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent. Polluting industries must seek permission to discharge waste into effluent bodies. The Pollution Control Board (CPCB) was constituted under this act.

1977 – The Water (Prevention and Control of Pollution) Cess Act provides for the levy and collection of cess or a fees on water consuming industries and local authorities.

1978 – The Water (Prevention and Control of Pollution) Cess Rules contains the standard definitions and indicate the kind of and location of meters that every consumer of water is required to affix.

1991 – Coastal Regulation Zone Notification puts regulations on various activities, including construction, are regulated. It gives some protection to the backwaters and estuaries.

Air

1948 – Factories Act and Amendment in 1987 was the first to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

1981 – Air (Prevention and Control of Pollution) Act provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the Central Pollution Control Board.

1982 – Air (Prevention and Control of Pollution) Rules defines the procedures of the meetings of the Boards and the powers entrusted on them.

1982 – Atomic Energy Act deals with the radioactive waste.

1987 – Air (Prevention and Control of Pollution) Amendment Act empowers the central and state pollution boards to meet with grave emergencies of air pollution.

1988 – Motor Vehicles Act states that all hazardous waste is to be properly packaged, labeled and transported.

Check your progress – 1

Note: a) Space is given below for your answer.

b) Compare your answer with those given at the end of this unit.

1. 1986 – The Environment Protection Act authorizes the Central Government to ---------- environmental aspects.
2. 1956 – The River Boards Act enables the states to enroll the Central Government in setting up an ---------- to resolve issues in interstate cooperation.
3. 1982 – Atomic Energy Act deals with the ----------.
4. 1988 – Motor Vehicles Act states that all ---------- is to be properly packaged, labeled and transported.

6.4 INTERNATIONAL ENVIRONMENTAL AGREEMENTS

At International level, there are a number of laws which deal with various aspect of environment protection regulation, conduct of environmentally harmful activities and provide for remedies in case of their breach. For this, a number of conventions are arranged and agreements are made.

(a). General

Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Aarhus, 1998.

Espoo Convention on Environmental Impact Assessment in a Trans boundary Context, Espoo, 1991

(b). Atmosphere

Convention on Long-Range Trans boundary Air Pollution (LRTAP), Geneva, 1979.

Environmental Protection: Aircraft Engine Emissions, Annex 16, vol. 2 to the Chicago Convention on International Civil Aviation, Montreal, 1981.

Framework Convention on Climate Change (UNFCCC), New York, 1992, including the Kyoto Protocol, 1997.

Georgia Basin-Puget Sound International Air shed Strategy, Vancouver, Statement of Intent, 2002.

Vienna Convention for the Protection of the Ozone Layer, Vienna, 1985, including the Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987.

U.S.-Canada Air Quality Agreement (bilateral U.S.-Canadian agreement on acid rain), 1986

(c). Freshwater resources

Convention on the Protection and Use of Trans boundary Watercourses and International Lakes (ECE Water Convention), Helsinki, 1992.

(d). Hazardous substances

Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal, Basel, 1989.

Convention on Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail, and Inland Navigation Vessels (CRTD), Geneva, 1989.

Convention on the ban of the Import into Africa and the Control of Trans boundary Movements and Management of Hazardous Wastes within Africa, Bamako, 1991.

Convention on the Trans boundary Effects of Industrial Accidents, Helsinki, 1992.

Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Rotterdam, 1998.

European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (AND), Geneva, 2000.

European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), Geneva, 1957.

FAO International Code of Conduct on the distribution and use of Pesticides, Rome, 1985.

Stockholm Convention Stockholm Convention on Persistent Organic Pollutants Stockholm, 2001.

Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Trans boundary Movement and Management of Hazardous Wastes within the South Pacific Region, Waigani, 1995.

Minamata Convention on Mercury, Minamata 2013.

(e). Marine environment – global conventions

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), London, 1972.

International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), London 1973 and 1978

International Convention for the Prevention of Pollution of the Sea by Oil, London 1954, 1962 and 1969.

International Convention on Civil Liability for Oil Pollution Damage (CLC), Brussels, 1969, 1976,1984 and 1992.

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND) 1971 and 1992, Brussels, 1971/1992.

International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS), London, 1996.

International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), London, 1990.

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties Intervention Convention, Brussels, 1969.

Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances OPRC-HNS Protocol, London, 2000.

United Nations Convention on the Law of the Sea LOS Convention, Montego Bay, 1982.

(f). Marine living resources

Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS), Monaco, 1996

Agreement on the Conservation of Albatrosses and Petrels

Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS), New York, 1992

Agreed Measures for the Conservation of Antarctic Fauna and Flora

Convention for the Conservation of Antarctic Seals

Convention for the Conservation of Antarctic Marine Living Resources

Protocol on Environmental Protection to the Antarctic Treaty

Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn, 1997

International Convention for the Conservation of Atlantic Tunas (ICCAT), Rio de Janeiro, 1966.

International Convention for the Regulation of Whaling (ICRW), Washington, 1946.

(g). Nature conservation and terrestrial living resources

World Heritage Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972.

Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973.

Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MoU)

International Tropical Timber Agreement, (ITTA), Geneva, 1994.

(h). Noise pollution

Working Environment (Air Pollution, Noise and Vibration) Convention, 1977

(i). Nuclear safety

Comprehensive Test Ban Treaty 1996

Convention on Assistance of a Nuclear Accident, Vienna 1986.

Convention on Early Notification of a Nuclear Accident, Vienna 1986.

Convention on Nuclear Safety, Vienna 1994.

Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water Vienna Convention on Civil Liability for Nuclear Damage, Vienna 1963.

Check your progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit.

1. State the Fresh Water Convention agreement**.**
2. Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia ----------.
3. Abbreviate ITTA.

6.5 MEDIA AND ENVIRONMENTAL AWARENESS

As far as the environmental issues are concerned, media either as a risk communicator, or as a promoter of data, information and good practices of any kind, should smooth the progress of people to become more environmentally responsible and cultivate an environmental awareness. Additionally, media could help people associate reasons and effects, thus to get informed and to reflect upon the given information, in order to understand the origins and the causes of the major environmental problems.

Generating public awareness and environmental friendly behaviors is a complex and multidimensional task. To achieve this, different kind of information and ways of presentation should be exploited. There is a need to use low cost and environmental friendly technologies in order to cultivate ecological attitudes. All the aforementioned could be accomplished by the use of digital media, and especially the Internet. Firstly, the blending of text and multimedia contributes to the presentation and decoding of complicated situations and events, and secondly, the proper choice of internet-based approach could be low cost and "green". Some Internet usages to raise the environmental awareness are the following:

Documentaries and amateur videos: as mentioned before, exposing an environmental situation or hazard could be a difficult endeavor. The power of pictures and videos to illustrate, captivates or shock, is undoubtedly, linked to understanding. Via the Internet, people have an instant, cost free and unlimited access to a great number of environmental documentaries or professional and amateur videos regarding nature and its protection via apposite websites, like www.youtube.com or similar.

Blogs, Wikis, Forums and educational portals : such websites, on the one hand give access to an vast amount of information regarding the planets and its protection, without any consumption of paper and ink, and on the other hand, provide a virtual space of communication and exchanging of information and ideas, without the burden of traveling.

Virtual environments and e-museums: which represent an attractive alternative for the enhancement of the environmental awareness, as the user has the opportunity to navigate and sometimes interact with the presented environment.

e-Learning : such educational practice has a double impact on the enhancement of environmental awareness. Firstly, it is an effective way for organizations and academic institutes to reduce their carbon footprint, with the elimination of face-to-face presence, and the paper and ink usage. Secondly, over the Internet there are many available courses regarding the nature, the environmental problems, the use of green technologies, the ecological friendly agriculture, the ecotourism, etc.

6.6 ROLE OF NGO'S IN PROTECTION FOR THE ENVIRONMENT IN INDIA

A Non-Governmental Organization is a social service organization working towards a better society. Our mission is to address issues like poverty and ignorance that are threatening and weakening our country's progress.

The NGO's constitute a worldwide net work interacting with Governments and Internal intergovernmental organization in shaping international environmental policies

1. Creating awareness among the public on current environmental issues and solutions.

2. Facilitating the participation of various categories of stakeholders in the discussion on environmental issues.

3. Conducting participatory rural appraisal.

4 Being involved in the protection of human rights to have a clean environment.

5 Protecting the natural resources and entrusting the equitable use of resources.

6 Data generation on natural resources, time line history of villages.

7 Analysis and monitoring of environmental quality.

8 Transferring information through newsletters, brochures, articles, audio visuals, etc.

9 Organizing seminars, lectures and group discussion for promotion of environmental awareness.

10 Helping the villages' administrative officials in preparation, application and execution of projects on environmental protection.

6.7 ENVIRONMENTAL MOVEMENTS IN INDIA

The environment in which we live plays a vital role in our survival. The environment includes all the natural resources such as air, water, land, forests, minerals, etc. It is our duty to protect the natural resources. However, due to some of the reason, there is a lot of misuse of these natural resources, in the form of land degradation, water pollution, air pollution, and deforestation.

All these factors lead to deterioration of our environment. There have been many efforts made in order to reclaim the environment by people through voluntary organizations, which are concerned about the environment. There are instances where people have revoked and adopted non-violent action movements for protecting their environment.

Our discussion would be on such environmental movements in India. We would be dealing with the Chipko Movement, the Appiko Movement in the Western Ghats, Vana Mahotsav initiated by K.M. Munshi, and also the environmental organizations such as the Green Peace and World Wide Fund for conserving forests and wildlife.

These environmental movements are an expression of the socio-ecological effects of narrowly conceived development based on short-term criteria of exploitation. The movements

reveal how the resource-intensive demands of development have built-in ecological destruction and economic deprivation.

Members have activated micro-action plans to safeguard natural resources and to provide the macro concept for ecological development at the national and regional levels.

The past five decades have witnessed a high rate of resource utilization. Intensive agricultural and industrial productions have paved the way for increase in demands for the resources. This has resulted in conflicts over natural resources.

These conflicts become more serious when the industrial technologies utilizing the resources face challenges from communities, whose survival is dependent upon these resources and are threatened by destruction and over exploitation of the resources. Such conflicts, which are based on the deteriorating condition of the natural resources, are leading to environmental movements at different levels.

6.7.1 Silent Valley Project

When the Kerala State Electricity Board announced plans to begin the construction of a 240 MW hydroelectric project over the Kunthipuzha river flowing through the Palakkad and Mallapuram districts in 1976, it triggered a wave of protests across the state. Soon it became India's first major environmental movement resulting in far-reaching changes in the way the nation cleared infrastructure projects.

It showed the enormous damage the project would cause by submerging 530 hectare of pristine evergreen forests rich in biodiversity. Known as the Silent Valley, a misnomer because the dense forests are teeming with life, it was one of the world's ecological hotspots. The Valley harboured a range of species endemic to the region, including the lion-tailed macaque that faced the threat of extinction.

No other environmental issue has raised more heat and dust in the country than silent valley. One reason is the very elemental nature of the controversy: whether or not to preserve this tropical forest belt, one of the few uninhabited areas in the entire country, for the future benefit of mankind. Legal strategies played an important role in saving Silent valley. The success of the Environmentalists was due to a combination of several factors, including the grass-root

campaign led by the Kerala Sastra Sahitya Parishad (KSSP); intense lobbying by several non-governmental organizations and influential environmentalists within and outside government; and international pressure exerted on Prime Minister Indira Gandhi. Prominent environmentalist, Zafar Futehally, headed the National Committee on Environmental Planning and Coordination (NCEPC), on the ecological planning of the Western Ghats appointed in 1976. This team was apparently under the impression that Silent Valley multi-purpose project, then expected to cost Rupees twenty five crores, was practically a fait accompli. This triggered off an enormous row, the echoes of which have by no means died down.

The two main opponents were KSSP and the Friends of the Trees. These two organizations got their moral and material support from a 'save silent valley' committee in Bombay, backed by individuals from the World Wild Life Fund, Bombay Natural History Society (BNHS), and the save Bombay committee. Various international bodies were consulted and some of the important ones were the International Union for Conservation of Nature and Natural Resources in Switzerland, which at its conference in Ashkabad in USSR in September 1978, called upon the Kerala government to abandon the project. Before the NCEPC could provide recommendations, the Kerala government convinced the Prime Minister then, Moraji Desai that the scheme should be given go-ahead. The debate grew really hot- on public platforms, where both KSSP and KSEB members spoke in the press. The happening at home and at international forums was good enough to persuade the next Prime Minister, Charan Singh to abandon the work on the project. At this juncture, the Central Government decided to send the country's most reputed agricultural scientist, Dr. M.S.Swaminathan to look at it. He endorsed the task force's opinion, recommending that the project be scrapped and the entire area of Silent Valley to be converted into a rain forest Biosphere Reserve.

In 1980, the then prime minister Indira Gandhi told the state government to abandon the project. She declared the area a National Park and by 1984 the necessary legislation was in place to ensure that status. The agitation led to the establishment of stringent clearances including a mandatory environmental impact assessment report to be submitted to the Central Government for clearance of any major project that had ecological implications.

The success of the 'Save Silent Valley' movement became the inspiration for similar agitations, including the Narmada Bachao Andolan and protests against the Tehri Dam. Today,

the virgin forests and the unparalleled beauty of the park bear silent testimony to what a determined band of environmentally conscious individuals can achieve if they combine forces.

6.7.2 Chipko Movement

The Chipko Movement was started in the northern Himalayan segment of Uttar Pradesh, the area that is well known as Uttarakhand. The word “chipko” refers “to stick” or “to hug”. The name of the movement comes from a word meaning “embrace”: where the villagers hug the trees, saving them by interposing their bodies between them and the contractors’ axes.

This became popular as “Chipko movement”. Chipko movement is a grassroot level movement, which started in response to the needs of the people of Uttarakhand. Most of the leaders of the Chipko Movement were village women and men who strove to save their means of subsistence and their communities. Sunderlal Bahuguna, a renowned Gandhian, with a group of volunteers and women started the non-violent protest by clinging to the trees to save them from felling.

This gave a start to the “Chipko Movement”. The main objective of this movement was to ensure an ecological balance and the survival of the tribal people whose economic activities revolved around these forests. His appeal to Mrs Gandhi resulted in the green-felling ban.

The Uttarakhand region is a highly remote area due to its precipitous slopes, with thin and fragile soils. The area is highly resourced with abundant water resources and forests. The people living in this region are farmers, whose major occupations are terrace cultivation and animal husbandry. The extensive network of roads, which have been built after the Indo-Chinese border conflict, made accessibility to this region easier.

As a result, the Uttarakhand region, which is known for rich minerals, soils, and forests, attracted many entrepreneurs. Soon the area became the object of exploitation by these entrepreneurs. Some products for which the region was exploited were timber, limestone, magnesium, potassium, etc. The major source of conflicts in this region was the exploitation of the forests by the entrepreneurs with the approval of the government.

The other reason for such conflicts was that the villagers were earlier denied the use of forests. The streamlined policies did not allow the local agriculturists and herders to cut the trees for fuel wood or for fodder and for certain other purposes.

Instead, they were told that dead trees and fallen branches would serve their needs. The agriculturists or herders could cut trees only for the construction of houses and for making implements. The policies were reframed, claiming that the overuse and misuse of the forests was causing deforestation.

Moreover, the timber and charcoal contractors conspired among themselves and blamed the local people for deforestation. The villagers, with the help of social workers, established labour and small-scale-producer co-operatives, which aimed at allowing the local people to share the benefits of development.

There continued long arguments between the villagers, timber contractors, social workers, and the personnel of the forest department. The first spark of the movement started in 1972 at Gopeshwar in Chamoli district when a local co-operative was not given permission to cut 12 ash trees for the purpose of building houses and for tool-making. Instead, the government sold the ash trees to a sports-goods manufacturing company for the purpose of making bats and tennis rackets.

The villagers appeal to the government went in vain. In protest, the villagers adopted a non-violent method and they stuck themselves to the trees to protect them from being felled. The villagers were successful in their effort and the government cancelled the permit given to the sports-goods manufacturing company. Thus, the Chipko Movement was started.

Such other incidents have become successful and the movement soon spread to other areas. The Chipko activists formed into groups and campaigned from village to village and informed people about the purpose and importance of the movement. The movement has been diversifying its activities. It is now collecting funds to take up research on the issues of forests, soil, and water conservation.

The 5,000-km trans-Himalaya foot march in 1981-1983 was crucial in spreading the Chipko message. Bahuguna coined the Chipko slogan: “ecology is permanent economy”. Chandi Prasad Bhatt, one of the earliest Chipko activists, fostered local industries based on the conservation and sustainable use of forest wealth for local benefit. Dhoom Singh Negi, with Bachni Devi and many village women, first saved trees by hugging them in the “Chipko embrace”.

The Chipko protests in Uttar Pradesh achieved a major victory in 1980 with a 15-year ban on green felling in the Himalayan forests of that state by the order of Mrs. Indira Gandhi, the then Prime Minister of India. Since then, the movement has spread to many states in the country.

In addition to the 15 year ban in Uttar Pradesh, felling in the Western Ghats and the Vindhyas has been stopped. It has also generated pressure for a natural resource policy that is more sensitive to peoples, needs and ecological requirements.

Thus, the Chipko Movement is an important environmental movement, which has gained considerable popularity and success by adopting a Gandhian non-violent method. The movement paved the way for many such environmental movements in the country.

6.7.3 Narmada Bachao Andolan, 1985

Narmada Bachao Andolan (NBA) is a social movement consisting of *adivasis*, farmers, environmentalists and human rights activists against a number of large dams being built across the Narmada River, which flows through the states of Gujarat, Madhya Pradesh and Maharashtra, all in India. Sardar Sarovar Dam in Gujarat is one of the biggest dams on the river and was one of the first focal points of the movement.

After 1947, investigations were carried out to evaluate mechanisms for using water from the Narmada River, which flows into the Arabian Sea after passing through the states of Madhya Pradesh, Gujarat. Interstate differences in implementing schemes and sharing of water made the Narmada Water Disputes Tribunal being constituted by the Government of India on 6 October 1969 to adjudicate over the disputes. As per the tribunal's decision, 30 major, 135

medium, and 3000 small dams, were granted approval for construction, including raising the height of the Sardar Sarovar dam.

While Medha Patkar established Narmada Bachao Andolan in 1989, the groups joined this national coalition of environmental and human rights activists, scientists, academics and project-affected people with a non-violent approach.

Their mode of campaign includes hunger strikes and garnering support from film and art personalities. Narmada Bachao Andolan, with its leading spokespersons Medha Patkar and Baba Amte, received the Right Livelihood Award in 1991. Amongst the major celebrities who have shown their support for Narmada Bachao Andolan are Booker Prize winner Arundhati Roy and Aamir Khan.

The Narmada Bachao Andolan has rendered a yeoman's service to the country by creating a high-level of awareness about the environmental and rehabilitation and relief aspects of Sardar Sarovar and other projects on the Narmada. But, after the court verdict it is incumbent on it to adopt a new role. Instead of 'damning the dam' any longer, it could assume the role of vigilant observer to see that the resettlement work is as humane and painless as possible and that the environmental aspects are taken due care of.

6.7.4 National Test Range at Baliapal

The central government is decided to develop a National Test Range at Baliapal in Balasore district, Orissa state. The Defence Ministry had been trying for the past four years to set up a National Test Range (NTR) - estimated cost of Rs 3,000 crore - to test newly- developed missiles, rockets and pilotless target aircraft.

Everyday, the people opposed at dawn and dusk, women and children gather in their lush green fields blowing conch-shells and beating brass utensils each time they spot a stranger in the area, while the men block village roads to reiterate their resolve to fight the creation of the NTR which they believe will bring economic disaster.

Village youth instead of working in the fields, vie with each other to enroll themselves as members of the *Marna Sena* (suicide squad) and guard entry points preventing government officials and their vehicles from entering the area.

The battle has now escalated with villagers imposing a ban on the movement of government personnel and vehicles. The Orissa Government on the other hand has clamped an undeclared "economic sanction" on the area, denying the villagers essential commodities and agriculture credits for the past three months in a bid to force them to leave their homes and surrender their rich fertile lands.

Villagers enforcing blockade

The administration has now taken the extreme step of imposing an unofficial economic blockade by stopping the supply of essential commodities and refusing to ply buses to lift local farming products.

For farmers, the area spread over 400 sq km along the seashore and comprising 132 villages, is a virtual goldmine with cash crops like betel-vines, coconuts and cashew besides profitable fishing in the shallow waters. Farmers earn an estimated Rs 20 crore a year from betel-vines alone. Local farmers say that the NTR project would not only destroy vast paddy land but also over 30,000 betel-vines, thousands of coconut trees and cashew plants worth over Rs 750 crore.

But the fear and panic had created a big gap between the administration and the people. That was amply illustrated recently when the Government, unable to meet village leaders, airdropped pamphlets explaining the Government's rehabilitation plans.

The Centre has announced Rs 127-crore rehabilitation package which envisages paying the villagers Rs 50,000 per acre of land, a chain of industries to absorb all persons to be rendered jobless and even compensation for government land under occupation of the villagers.

But the villagers are adamant and have received support from many opposition parties. Members from the affected villages are running a parallel state and peoples' courts, setting up a network to bring in essential commodities and sending local products outside.

6.8 SUSTAINABLE DEVELOPMENT

Natural resource endowment

India is richly endowed with mineral resources, which include fossil fuels, ferrous and non-ferrous ores, and industrial minerals. There are about 20 000 known mineral deposits in the country and as many as 87 minerals (4 fuels, 11 metallic, 50 non-metallic, 22 minor minerals) are being exploited (TERI, 2001b). The country has abundant reserves of bauxite, coal, dolomite, iron ore, manganese, limestone, magnesite and adequate reserves of chromite, graphite, lignite, and rock salt.

Fresh water

India is considered rich in terms of annual rainfall and total water resources available at the national level. The average annual rainfall, equivalent to about 4000 billion cubic metres (BCM), however, is very unevenly distributed both spatially as well as temporally. This causes severe regional and temporal shortages. Utilizable resource availability in the country varies considerably from 18,417 cubic metres in the Brahmaputra valley to as low as 180 cu m in the Sabarmati basin. Precipitation varies from 100 mm a year in western Rajasthan to over 9000 mm a year in the north-eastern state of Meghalaya. With 75% of the rain falling in the four monsoon months and the other 1,000 BCM spread over the remaining eight months, Indian rivers carry 90% of the water between June and November, making only 10% of the river flow available during the other six months.

Sustainable development has been described in terms of three dimensions, domains or pillars. In the three-dimension model, these are seen as "economic, environmental and social" or "ecology, economy and equity"; this has been expanded by some authors to include a fourth pillar of culture, institutions or governance.

Ecology

The ecological sustainability of human settlements is part of the relationship between human and their natural, social and built environments also termed human ecology, this broadens the focus of sustainable development to include the domain of human health. Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development; addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species.

Environment

Environmental sustainability concerns the natural environment and how it endures and remains diverse and productive. Since natural resources are derived from the environment, the state of air, water, and the climate are of particular concern. Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet. This, for example, entails using water sustainably, utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).

An unsustainable situation occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. Inherently the concept of sustainable development is intertwined with the concept of carrying capacity. Theoretically, the long-term result of environmental degradation is the inability to sustain human life. Such degradation on a global scale should imply an increase in human death rate until population falls to what the degraded environment can support. If the degradation continues beyond a certain tipping point or critical threshold it would lead to eventual extinction for humanity.

Integral elements for a sustainable development are research and innovation activities. A telling example is the European environmental research and innovation policy, which aims at defining and implementing a transformative agenda to greening the economy and the society as a

whole so to achieve a truly sustainable development. Research and innovation in Europe is financially supported by the programme Horizon 2020, which is also open to participation worldwide. A promising direction towards sustainable development is to design systems that are flexible and reversible.

Agriculture

Sustainable agriculture consists of environmental-friendly methods of farming that allow the production of crops or livestock without damage to human or natural systems. It involves preventing adverse effects to soil, water, biodiversity, surrounding or downstream resources—as well as to those working or living on the farm or in neighboring areas. The concept of sustainable agriculture extends inter-generationally, passing on a conserved or improved natural resource, biotic, and economic base rather than one which has been depleted or polluted. Elements of sustainable agriculture include permaculture, agroforestry, mixed farming, multiple cropping, and crop rotation. Numerous sustainability standards and certification systems have been established in recent years, offering consumer choices for sustainable agriculture practices. These include Organic certification, Rainforest Alliance, Fair Trade, UTZ Certified, Bird Friendly, and the Common Code for the Coffee Community (4C).

Energy

Sustainable energy is clean and lasts for a long period of time. Unlike the fossil fuel that most of the countries are using, renewable energy only produces little or even no pollution. The most common types of renewable energy in US are solar and wind energy; solar energy is commonly used on public parking meter, street lights and the roof of buildings. Wind has expanded quickly, generating 12,000 MW in 2013. Most of California's fossil fuel infrastructures are sited in or near low-income communities, and have traditionally suffered the most from California's fossil fuel energy system. These communities are historically left out during the decision-making process, and often end up with dirty power plants and other dirty energy projects that poison the air and harm the area. These toxicants are major contributors to health problems in the communities. As renewable energy becomes more common, fossil fuel infrastructures are replaced by renewable, providing better social equity to these communities.

Overall, and in the long run, sustainable development in the field of energy is also deemed to contribute to economic sustainability and national security of communities, thus being increasingly encouraged through investment policies.

Transportation

Transportation is a large contributor to greenhouse gas emissions. It is said that one-third of all gasses produced are due to transportation. Some western countries are making transportation more sustainable in both long-term and short-term implementations. An example is the modifications in available transportation in Freiburg, Germany. The city has implemented extensive methods of public transportation, cycling, and walking, along with large areas where cars are not allowed.

Since many western countries are highly automobile-orientated areas, the main transit that people use is personal vehicles. About 80% of their travel involves cars. Therefore, California, deep in the automobile-oriented west, is one of the highest greenhouse gases emitters in the country. The federal government has to come up with some plans to reduce the total number of vehicle trips in order to lower greenhouse gases emission.

Improve public transit through the provision of larger coverage area in order to provide more mobility and accessibility, new technology to provide a more reliable and responsive public transportation network.

Encourage walking and biking through the provision of wider pedestrian pathway, bike share station in commercial downtown, locate parking lot far from the shopping center, limit on street parking, and slower traffic lane in downtown area.

Increase the cost of car ownership and gas taxes through increased parking fees and tolls, encouraging people to drive more fuel efficient vehicles. They can produce social equity problem, since lower people usually drive older vehicles with lower fuel efficiency. Government can use the extra revenue collected from taxes and tolls to improve the public transportation and benefit the poor community.

Other states and nations have built efforts to translate knowledge in behavioural economics into evidence-based sustainable transportation policies.

Check Your Progress – 3

Note: a) Space is given below for your answer.

b) Compare your answer with those given at the end of this unit.

8. Abbreviate NEAA.

9. Prevention and Control of Pollution Act, 1981 referred to as ----------.

10. What are the three dimensions of sustainable development?

11. Narmada Bachao Andolan announced the arrival of the India Greens, protesting against ----------development.

12. The silent valley project has been called off in the year ----------.

6.9 LET US SUM UP

In this unit you have learnt in detail about environmental policy, environmental laws, International environmental agreements, global conventions, environmental awareness, environmental movements and sustainable development. The origin, development, role of chipko movement, sailent valley and normadha valley movement are discussed in detailed manner.

6.10 EVALUATION

1. What are all the Environmental Policy and Laws after Independence ?
2. What is the role of Media on Environmental awareness ?
3. What is the role of NGO's in protection for the Environment in India ?
4. Explain the Environmental movements in India.
5. Explain the Chipko movement.
6. Explain Sailent Valley movement.

7. Explain Narmadha Bachao Andolan.
8. What is sustainable development ?

UNIT END ACTIVITIES

Make a list of environmental policies in India and write about how these policies are effective in terms of environmental pollution in our country

POINTS FOR DISCUSSION

Discuss the various environmental problems in India and explain the way of controlling the problem.

ANSWER TO CHECK YOUR PROGRESS

1. Protect and improve.
2. Advisory river board.
3. Radioactive waste.
4. Hazardous waste.
5. Convention on the Protection and Use of Trans boundary Watercourses and International Lakes (ECE Water Convention), Helsinki, 1992.
6. Raptors Memorandum of Understanding.
7. International Tropical Timber Agreement.
8. National Environment Appellate Authority.
9. Air Act, 1981.
10. economic, environmental and social.
11. destructive.
12. November 1983.

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan “Environmental science education” Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P “Environmental Education”, Ram Publishers, Chennai.(2002).
3. Veera Bala Rastogi and Jayaraj “Animal ecology and distribution of animals”, Kedar Nath Ram nath, New Delhi. (1984).
4. Lange, Robert R. “Environmental Education Needs Assessment and Evaluation”, Colorado. (1980).

ENVIRONMENT RESEARCH PROGRAMME

UNIT-VII

STRUCTURE

7.1 INTRODUCTION

You have studied the attempts to conserve the environmental assets through the act and various policies in previous chapter. In this unit, we shall deal with the need for environmental resource management and discuss the environmental protection and sustainability. You can understand the global early warning systems for natural hazards.

7.2 OBJECTIVES

At the end of the unit, you will be able to

- Define the environmental resource management
- Understand the interaction of human societies on the environment.
- Identify the factors affected by conflicts that rise between meeting needs and protecting resources.
- Understand the environmental protection and sustainability.
- Understand the environmental management system.
- Understand the global early warning systems for natural hazards.
- Understand the environmental values.

7.3 ENVIRONMENTAL RESOURCE MANAGEMENT

Environmental resource management is the management of the interaction and impact of human societies on the environment. Environmental resources management aims to ensure that ecosystem services are protected and maintained for future human generations, and also maintain ecosystem integrity through considering ethical, economic, and scientific (ecological) variables. Environmental resource management tries to identify the factors affected by conflicts that rise between meeting needs and protecting resources. It is thus linked to environmental protection and sustainability.

i. Significance of Environmental resource management

Environmental resource management is an issue of increasing concern; it is influencing global socio-political frameworks such as the Brundtland Commission's ‘Our

Common Future', which highlighted the integrated nature of environment and international development. The environment determines nature of every object around the sphere.

ii. Scope of Environmental resource management

Environmental resource management can be viewed from a variety of perspectives. Environmental resource management involves the management of all components of the biophysical environment, both living (biotic) and non-living (abiotic). This is due to the interconnected and network of relationships amongst all living species and their habitats. The environment also involves the relationships of the human environment, such as the social, cultural and economic environment with the biophysical environment. The essential aspects of environmental resource management are ethical, economical, social, and technological. These underlie principles and help make decisions.

iii. Sustainability

Sustainability and environmental resource management involves managing economic, social, and ecological systems within and external to an organizational entity so it can sustain itself and the system it exists in. In context, sustainability implies that rather than competing for endless growth on a finite planet, development improves quality of life without necessarily consuming more resources. Sustainably managing environmental resources requires organizational change that instills sustainability values that portrays these values outwardly from all levels and reinforces them to surrounding stakeholders. The end result should be a symbiotic relationship between the sustaining organization, community, and environment.

iv. Public sector

The public sector comprises the general government sector plus all public corporations including the central bank. In environmental resource management the public sector is responsible for administering natural resource management and implementing environmental production legislation. The traditional role of the public sector in environmental resource management is to provide professional judgment through skilled technicians on behalf of the public. With the increase of intractable environmental problems, the public sector has been led to

examine alternative paradigms for managing environmental resources. This has resulted in the public sector working collaboratively with other sectors (including other governments, private and civil) to encourage sustainable natural resource management behaviours.

v. Private sector

The private sector comprises private corporations and non-profit institutions serving households. The private sector's traditional role in environmental resource management is that of the recovery of natural resources. Such private sector recovery groups include mining (minerals and petroleum), forestry and fishery organisations. Environmental resource management undertaken by the private sectors varies dependent upon the resource type, that being renewable or non-renewable and private and common resources. Environmental managers from the private sector also need skills to manage collaboration within a dynamic social and political environment.

vi. Civil society

Civil society comprises associations in which societies voluntarily organise themselves into and which represent a wide range of interests and ties. These can include community-based organisations, indigenous peoples' organisations and non-government organizations. Functioning through strong public pressure, civil society can exercise their legal rights against the implementation of resource management plans, particularly land management plans. The aim of civil society in environmental resource management is to be included in the decision-making process by means of public participation. Public participation can be an effective strategy to invoke a sense of social responsibility of natural resources. Recent successful cases have put forward the notion of integrated management. It shares a wider approach and stresses out the importance of interdisciplinary assessment. It is an interesting notion that might not be adaptable to all cases.

7.4 DATA BASE MANAGEMENT FOR ENVIRONMENTAL APPRAISAL

Environmental management system (EMS) refers to the management of an organization's environmental programs in a comprehensive, systematic, planned and documented

manner. It includes the organizational structure, planning and resources for developing, implementing and maintaining policy for environmental production.

The most widely used standard on which an EMS is International Organization for Standardization (ISO) 14001.

An environmental management information system (EMIS) is an information technology solution for tracking environmental data for a company as part of their overall environmental management system.

7.4.1 The goals of EMS

The goals of EMS are to increase compliance and reduce waste:

- Compliance is the act of reaching and maintaining minimal legal standards. By not being compliant, companies may face fines, government intervention or may not be able to operate.
- Waste reduction goes beyond compliance to reduce environmental impact. The EMS helps to develop, implement, manage, coordinate and monitor environmental policies. Waste reduction begins at the design phase through pollution prevention and waste minimization. At the end of the life cycle, waste is reduced by recycling.

7.4.2 Features of EMS

The features of an environmental management system (EMS) are as follows:

- Serves as a tool, or process, to improve environmental performance and information mainly "design, pollution control and waste minimization, training, reporting to top management, and the setting of goals".
- Provides a systematic way of managing an organization’s environmental affairs.
- EMS assists with planning, controlling and monitoring policies in an organization.
- Gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes.

- Creates environmental buy-in from management and employees and assigns accountability and responsibility.
- Sets framework for training to achieve objectives and desired performance.
- Helps understand legislative requirements to better determine a product or service's impact, significance, priorities and objectives.
- Focuses on continual improvement of the system and a way to implement policies and objectives to meet a desired result. This also helps with reviewing and auditing the EMS to find future opportunities.
- Encourages contractors and suppliers to establish their own EMS.

7.4.3 Environmental monitoring

Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. All monitoring strategies and programmes have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analysed statistically and published. The design of a monitoring programme must therefore have regard to the final use of the data before monitoring starts.

7.4.4 Air quality monitoring

Air quality monitoring is performed using specialized equipment and analytical methods used to establish air pollutant concentrations.

Air monitors are operated by citizens, regulatory agencies, and researchers to investigate air quality and the effects of air pollution.

Interpretation of ambient air monitoring data often involves a consideration of the spatial and temporal representativeness of the data gathered, and the health effects associated with exposure to the monitored levels.

Since air pollution is carried by the wind, consideration of anemometer data in the area between sources and the monitor often provides insights on the source of the air contaminants recorded by an air pollution monitor.

7.4.5 Environmental soil Monitoring

Environmental soil science is the study of the interaction of humans with the pedosphere as well as critical aspects of the biosphere, the lithosphere, the hydrosphere, and the atmosphere. Environmental soil science addresses both the fundamental and applied aspects of the field including: buffers and surface water quality, vadose zone functions, septic drain field site assessment and function, land treatment of wastewater, storm water, erosion control, soil contamination with metals and pesticides, remediation of contaminated soils, restoration of wetlands, soil degradation, nutrient management, movement of viruses and bacteria in soils and waters, bioremediation, application of molecular biology and genetic engineering to development of soil microbes that can degrade hazardous pollutants, land use, global warming, acid rain, and the study of anthropogenic soils. Much of the research done in Environmental soil science is produced through the use of models.

7.4.6 Water quality monitoring

Water quality monitoring is of little use without a clear and unambiguous definition of the reasons for the monitoring. Almost all monitoring (except perhaps remote sensing) is in some part invasive of the environment under study and extensive and poorly planned monitoring carries a risk of damage to the environment. This may be a critical consideration in wilderness areas or when monitoring very rare organisms or those that are averse to human presence. Some monitoring techniques, such gill netting fish to estimate populations, can be very damaging, at least to the local population and can also degrade public trust in scientists carrying out the monitoring.

7.4.7 Environmental monitoring data management systems

Given the multiple types and increasing volumes and importance of monitoring data, commercial software Environmental Data Management Systems (EDMS) or E-MDMS are

increasingly in common use by regulated industries. They provide a means of managing all monitoring data in a single central place. Quality validation, compliance checking, verifying all data has been received, and sending alerts are generally automated. Typical interrogation functionality enables comparison of data sets both temporarily and spatially. They will also generate regulatory and other reports.

Check Your Progress – 1

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

1. Environmental resource management involves the management of all components of the biophysical environment, both living and ----------

2. Give any two important features of an environmental management system.

3. The most widely used standard on which an EMS is International Organization for Standardization ----------.

4. The goals of EMS are to increase compliance and reduce ----------.

7.5 GLOBAL EARLY WARNING SYSTEMS FOR NATURAL HAZARDS

To be effective, early warning systems for natural hazards need to have strong focus on the people exposed to risk, and the relevant factors in that risk, whether arising from the natural hazards or social vulnerabilities, and from short-term or long-term processes. Disasters are increasing in number and severity and international institutional frameworks to reduce disasters are being strengthened under United Nations oversight. Since the Indian Ocean tsunami of 26 December 2004, there has been a surge of interest in developing early warning systems to cater to the needs of all countries and all hazards.

1. Disasters and disaster trends

A disaster, precipitated by a natural hazard, can be defined as ‘a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources’ (ISDR 2004). A disaster thus arises from the combination of the hazard event or episode, the conditions of vulnerability to that hazard and the insufficiency of capacity or measures to cope with the hazard. Furthermore, the term implies a powerlessness that is inconsistent with human capacities to understand and reduce disasters.

The statistics of recorded disaster data show that over the last decade (1995–2004) nearly 6000 disasters were recorded, accounting for about 900000 dead, US$ 738 billion material losses and 2500 million people affected. Disasters have mostly hydro-meteorological origins, from extremes of wind, rainfall and temperature, but earthquakes figure high in the death rates, owing mostly to inadequate building design. Disasters disproportionately affect poor people and poor countries and are increasingly recognized as a major handicap to the development of many countries.

The estimation of long-term trends in disasters depends somewhat on the period used and the dataset. Comparing the most recent decade 1995–2004 with the previous decade 1985–1994, the CRED data shows the number of people affected increased 1.5 times, economic damage increased 1.8 times and total deaths increased 2.0 times. The latter figure is heavily affected by the 26 December 2004 tsunami tragedy. Prior to that date, the trend in death rates since the 1950s was downward, as a result of improving early warning systems, better preparedness and response, including systematic food aid systems. Together these now avoid the massive famines and flood losses that earlier prevailed.

2. Early warning systems and their elements

The expression ‘early warning’ is used in many fields to mean the provision of information on an emerging dangerous circumstances where that information can enable action in advance to reduce the risks involved. Early warning systems exist for natural geophysical and

biological hazards, complex socio-political emergencies, industrial hazards, personal health risks and many other related risks.

In the present setting we are concerned with geophysical hazards—storms, floods, droughts, landslides, volcanic eruptions, tsunamis, etc—and related hazards that have a geophysical component, such as wild-land fire, locust plagues and famines. In the current UN-ISDR terminology, early warning is defined as 'the provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response' (ISDR 2004).

To be effective and complete, an early warning system needs to comprise four interacting elements:

(i) Risk knowledge

Knowledge of the relevant hazards and knowledge of the vulnerabilities of people and society to these hazards.

(ii) Monitoring and warning service

A technical capacity to monitor hazard precursors, to forecast the hazard evolution and to issue warnings.

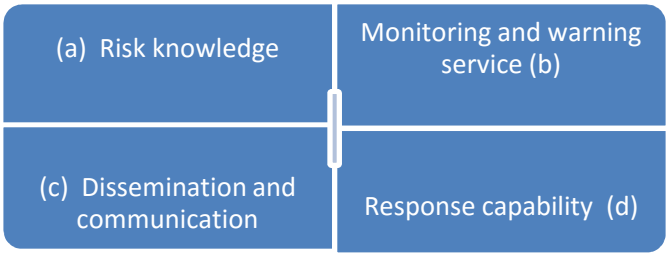
(iii) Dissemination and communication

The dissemination of understandable warnings, and prior preparedness information, to those at risk.

(iv) Response capability.

Knowledge, plans and capacities for timely and appropriate action by authorities and those at risk.

While this set of four elements appears to have a logical sequence, in fact each element has direct two-way linkages and interactions with each of the other elements.



The second element, the monitoring and warning service, is the most well-recognized part of the early warning system, but experience has shown that technically high-quality predictions by themselves are insufficient to achieve the desired reduction in losses and impacts. The human factor in early warning systems is very significant. Failures in early warning systems typically occur in the communication and preparedness elements. This was true of Hurricane Katrina which affected New Orleans in late August 2005, though in this case there was the additional failure in respect to risk knowledge, namely a lack of full public and political appreciation of the core vulnerability of the inadequate levees and the consequences of their structural failure or overtopping by storm surges. In the case of the December 2004 Indian Ocean tsunami, there were major failures in all four elements.

It should be noted that in order to sustain the four elements over the long run, it is necessary to have strong political commitment and durable institutional capacities, which in turn depend on public awareness and an appreciation of the benefits of effective warning systems. Public awareness and support is often high immediately after a major disaster event—such moments can be capitalized on to strengthen and secure the sustainability of early warning systems.

3. A broader view of natural risk

If disasters arise from the concatenation of multiple factors, natural and social, then in principle at least, an early warning system should address all of the factors relevant to the particular risk. From this perspective it is desirable to monitor and provide early warning and foresight not only on the short-term precipitating hazards and geophysical conditions but also on the relevant longer-term factors such as declining environmental state, risk-raising development practices and projects, risk-altering policy changes, the status of social communications and capacities, trends in food markets, settlement trends and migration, conflict and health status.

This involves a wide range of time frames, and diverse methodologies for monitoring and forecasting.

It is important, however, not to gloss over the very specific characteristics of the different hazards. For example, tsunamis and storm surges both cause coastal inundation but the detection and monitoring methods, lead-time, and duration of the hazard and response actions are very different. A multi-hazard approach should not be allowed to force generalities or centralized control upon warning systems, but must be tailored to the needs of each hazard and built upon the specific technical capabilities required and the available institutional capacities. The need is for a coordinated 'system of systems'. Much remains to be elaborated in the practical implementation of these ideas.

4. The linear paradigm of model-based early warning systems

The current view of early warning systems comprises a 'warning chain', a linear set of connections from observations through warning generation and transmittal to users. In the meteorological community the term 'end-to-end' warning system is often used. The end-to-end concept aims to make forecasts and warnings more relevant and useable to end-users, and has evolved partly in response to the commercialization imperative in many national meteorological services, as well as through efforts to make better practical use of the probabilistic and weakly predictive seasonal forecasts of the El Niño phenomenon. It emphasizes the necessity to have all the links in the early warning chain in place and systematically connected.

At the heart of all early warning systems is some sort of model that describes the relevant features of the hazard phenomenon and its impacts, particularly their time evolution. The model provides the means to make projections of what might happen in the future—and therefore what actions might be desirable in response. Models may be as elaborate as the physics-based global numerical weather prediction models, or as straightforward as 'common knowledge' mental models (e.g. that the noisy approaching tsunami wave will arrive in a few minutes). They may be slowly evolving, as in a drought model where the loss of soil moisture may occur over months, or very rapid, such as in an earthquake where the differential speed of

electromagnetic signals relative to seismic waves can be used to automatically shut down a distant sensitive system a few seconds before damaging stresses occur.

Models also underlie the other parts of the warning system, such as the likely impacts of a hazard, the way warnings are communicated and acted on, and the dynamics of evacuation processes, but these vulnerability and response process models are generally much less developed than the geophysical process models.

All models are driven by a specification of an initial state, which must be obtained by observations (or from the output of an upstream observation-driven model). Observation systems can be expensive to install and operate and are often rather inadequate, especially in poorer countries. The initial state is, therefore, always imperfectly known, owing to imperfect spatial representation, instrument error and absence of data on some relevant factors. These uncertainties of the initial state propagate through the models, and together with errors in the model physics and representations thereof and random noise factors, result in uncertainty in the model estimates of future conditions. Warnings are, therefore, inherently probabilistic, even if based on sound physics and presented in a categorical format. Of note are forecasts of seasonal climate anomalies, which are strongly affected by system noise and uncertainty, and can only be represented in probability terms, and where it must be left to the end-user to judge the possible impact consequences of the projected possible climate outcomes.

Currently, tsunami warnings mostly are based on simple statistical relationships with precursor seismic observations, but these latter observations do not allow accurate prediction of the oceanic response, and so the false warning rates are high and the probability characteristics are poorly known. Usually, the warnings are provided only in categorical forms that usually require immediate response action. However, developments in ocean observation systems and in ocean wave propagation and coastal inundation models are in place to improve this situation in the near future.

5. Shortcomings of the linear paradigm

Scientists and technologists are typically the core stakeholders in early warning systems, as they are the custodians of the geophysical and technical knowledge base upon which

the warning system relies, and they are generally very motivated to use that knowledge for the good of society. As a result, early warning systems tend to be largely conceived as hazard-focused, linear, top-down, expert driven systems, with little or no engagement of end-users or their representatives. It can be noted, however, that people generally are not interested in early warning systems until some personally threatening event arises, and so most of the time are happy to leave the matter to the experts.

While the prevailing end-to-end linear paradigm is an advance on previous techno-centric concepts it nevertheless retains a number of shortcomings, as follows:

1. The focus still tends to remain on the hazard, with less emphasis on the vulnerabilities, risks and response capacities,
2. The different hazards are typically dealt with by separate independent technical institutions, with few synergies or mutual benefits being sought,
3. The dominance of the expert can lead to difficulties in user appreciation of such things as the meaning of a warning, warning uncertainty, the nature of false alarms and the necessary responses to different types of warnings,
4. The role of research and knowledge from outside the core area of expertise is often not acknowledged,
5. There is little engagement or empowerment of those at risk in the design and operation of the warning system, and hence a tendency by users to lack any sense of ownership in the system and to mistrust the experts and authorities,
6. There are few systematic mechanisms to improve the system through the incorporation of the knowledge, experience and feedback from users and those at risk, and
7. Weak public engagement and recognition tends to lead to weak political and budgetary support for the warning system.

The Hurricane Katrina disaster is a case in point where the meteorological warnings of wind speed, storm surge and rainfall were accurate and frequently communicated many hours in advance but the public and official engagement and responses to the warnings were inadequate. Similar experiences elsewhere have shown that to be effective, early warning systems must be both technically systematic and people-centered.

The ‘people-centered’ characteristic requires many systematic approaches and diverse activities spanning the four elements of early warning systems described above, such as: identifying target populations, especially the vulnerable and disadvantaged and interacting with them to determine needs and capacities; conducting town meetings and involving communities in exploring and mapping their risks and planning their responses; fostering the development by communities of monitoring and warning systems for local risks; generating public information tailored to target groups and making innovative use of the media and education systems; establishing people-focused benchmarks and performance standards for technical warning services; developing formal mechanisms for public representatives to monitor and oversee warning system design; using surveys to measure public awareness and satisfaction; creating monuments, publications, annual events and other anchors of public memory and learning; providing training on social factors for technical experts, authorities and communicators who operate the warning system; conducting research on factors that enhance or impede human understanding of and response to warnings; and providing exercises and simulations to enable people to experience and practice warning interpretation and responses.

It is important to recognize that these diverse activities cannot be undertaken or directed by any one organization, but require the coordinated participation of many different types of organizations, bound by a consensus of commitment to the ‘people-centered’ concept, and to the idea of an integrated system that is measured by its performance—namely protecting those at risk. National platforms for disaster reduction, stakeholder roundtables or inter-departmental committees should be empowered or established to organize the required coordination. The core technical agencies can play a key role by demanding the establishment of such mechanisms and supporting them with specialized technical information.

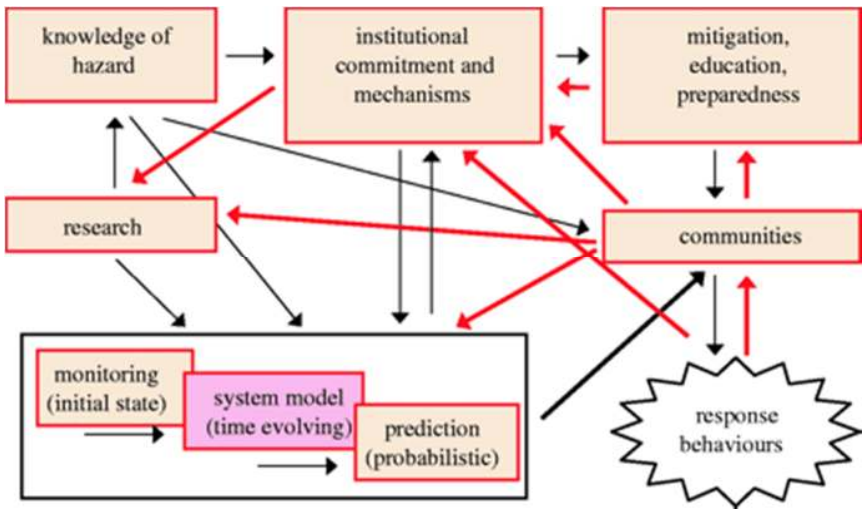
6. An integrated systems model for early warning systems

Early warning systems have evolved in line with the development and application of scientific knowledge. Four developmental stages can be distinguished:

1. Pre-science early warning systems. Warnings, if any, may be based on unrelated factors such as meteor occurrence, cloud shapes, plant flowering or fruiting performance, etc.,

but also may be based on indigenous observations of relevant factors such as the state of the oceans or visibility of the stars,

2. *Ad hoc* science-based early warning systems. These are systems such as are often established on the initiative of scientists or community groups concerned with particular hazards, such as near-Earth space objects, a nearby volcano or a flood-prone river,
3. Systematic end-to-end early warning systems. The best known and most developed are those of national meteorological services, for weather-related hazards. Typically these systems operate under a country-wide mandate and involve the organized, linear and largely uni-directional delivery by experts of warning products to users, and
4. Integrated early warning systems. This concept, as proposed here and illustrated in figure emphasizes the following characteristics: the linkages and interactions among all the elements necessary to effective early warning and response, the role of the human elements of the system and the management of risks rather than just warning of hazards.



The integrated model proposed in figure includes the core warning system elements, but in addition contains two new key features. The first is the inclusion of actors that often are not recognized as part of the warning system, most notably the political-administrative supporting entities, the district and community actors and the research community. The second feature is the explicit inclusion of multiple linkages and feedback paths, particularly from affected populations through their organizations to the political and technical actors. The model could be elaborated further for the particular circumstances of countries, e.g. to better specify the

district-level and community-level elements or the collaborative roles of different discipline-based technical institutions (e.g. such as seismological, oceanographic and meteorological organizations in a tsunami early warning system).

The figure is largely conceived as a nationally based system, but it is worth noting that many warning systems depend on regional and international cooperation to secure the exchange of necessary data and warnings. This is not a simple matter to arrange, however, as sovereign states can view their data as having strategic or commercial value, and for these reasons can deny or limit its exchange. In the field of meteorology, many years of discussion under the auspices of the World Meteorological Organization (WMO), a specialized technical agency of the United Nations, have led to formal agreements on the types of data that are routinely exchanged (WMO 1995). Much remains to be done to achieve similar levels of agreement in other hazard fields, e.g. in respect to rainfall and river flow data required for flood warnings in shared river basins and seismic data for tsunami warnings.

Underlying the integrated model is the important foundational assumption that we are dealing with a *system*, defined here as a set of elements and associated linkages designed to achieve a particular result—namely the reduction of risk for target populations and assets through early warning. The system is judged on its effectiveness at delivering the desired result, and can only be effective if the elements and the linkages are well-understood, well-designed and well-operated.

7. Systems-oriented research needs for early warning

Early warning systems require a broad multidisciplinary knowledge base, building on the substantial existing discipline-based research in the geophysical, environmental and social science fields. There is a need for more systemic, cross-cutting and applied research, including on the following topics:

1. development and use of geospatial data models, risk maps and scenarios,
2. cost-effective observations systems,
3. data generation and assimilation (e.g. bathymetry for tsunami models),
4. improvement of core prediction system models and prediction tools,

5. warning decision system tools for disaster managers,
6. management under warning uncertainty,
7. evaluation and comparison of warning communication methods,
8. models of human response behaviour including evacuations,
9. visualization of impacts and response options for community preparedness,
10. operationalization of the 'all-hazards' approach,
11. role of early warning as an adaptation to climate change,
12. warning system performance, indicators, benchmarks, and
13. economic assessments of warning system effectiveness.

The last two topics are of critical importance. If an early warning system is to be justified on its benefits, we need to define and measure not only the benefits but also the contribution made by each part of the system. We must also develop a systems culture that sets and achieves well-defined performance objectives and standards for each system.

8. Recent moves to develop better early warning systems

The December 2004 tsunami shone an intense spotlight on questions of early warning systems and preparedness, leading most notably to the call by United Nations Secretary General Kofi Annan in January 2005 for a global warning system for all hazards with no country left out. This was to be followed later in the year by his request to the International Strategy for Disaster Reduction (ISDR) secretariat to coordinate a global survey of early warning systems, with a view to identifying gaps and opportunities, as a basis for developing such global capacities .

9. Institutional frameworks

The task of putting science to work in policy and practice can only be achieved through sound institutional mechanisms—at national, regional and international levels. The major failures of early warning systems over recent times have been failures largely of institutions rather than science. Institutions are required to capture and sustain political commitment, to capitalize on and apply existing scientific knowledge, to assess risks and manage

investments in systems, to globalize and systematize early warning systems, and to guide and resource underpinning scientific research.

Early warning systems are a well-recognized element of the ISDR and its predecessor the International Decade for Natural Disaster Reduction (IDNDR). The ISDR mechanism was initiated by the UN General Assembly (UN 2000) as a vehicle for shared agenda setting and action on disasters by governments, UN agencies, regional organizations and civil society organizations (ISDR 2005*b*). These organizations have primary responsibility for developing and supporting operational early warning systems. The ISDR system is supported by a secretariat that provides advocacy, policy development, and information and supports countries through outreach units in the America, Africa and Asia. The ISDR system advocates for disaster reduction and encompasses a wide range of networks in governments, academia and non-governmental organizations (NGOs). It has fostered considerable activity on early warning issues, including international conferences on early warning, a working group on early warning, the establishment of the ISDR Platform for the Promotion of Early Warning (PPEW), and the development of the IEWP.

Check Your Progress – 2

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

5. The statistics of recorded disaster data show that over the last decade (1995-2004) nearly ---------- disasters were recorded.

6. Knowledge of the relevant hazards, and of the vulnerabilities of people and society to these hazards is called ----------.

7. Early warning systems have evolved in line with the development and application of ----------.

8. Early warning systems require a broad multidisciplinary ----------.

7.6 SOCIETY, CULTURE AND ENVIRONMENT

The formation of Social and Cultural aspects of human being is mean by society.

"Culture" is the essence of a society. Culture is one of the most difficult to comprehend, take account of and harness to advantage.

Environment is a combination of both living and non-living components. The living component is biological or biotic and the non-living component is physical or abiotic. The dictionary meaning of the word 'environment' is 'surrounding'. Environment refers to the sum total of conditions which surround man at the given point in 'space and time'.

Safety culture

The organizational preconditions to major systems failures are seen as increasingly important for risk management. Reasons for this failure outlines four key theoretical questions for safety culture researchers

1. The fact that culture acts simultaneously as a precondition both for safe operations and for the oversight of incubating hazards;

2. The challenge of dealing with complex and ill-structured hazardous situations where decision makers are faced with deep forms of uncertainty represented by incompleteness of knowledge or ignorance;

3. The need to consider the construction of risk perceptions in workgroups, and to view risk acceptability as the outcome of a process of social negotiation; and

4. The fact that institutional politics and power are critical for determining the achievement of safety culture goals, and in particular that of organizational learning.

7.7 ETHICAL VALUES OF ENVIRONMENTAL RESOURCE MANAGEMENT

Environmental resource management strategies are intrinsically driven by conceptions of human nature relationships. Ethical aspects involve the cultural and social issues relating to the environment, and dealing with changes to it. "All human activities take place in the context of certain types of relationships between society and the bio-physical world (the rest of nature)," and so, there is a great significance in understanding the ethical values of different groups around the world.

7.7.1 Environmental Values

Environmental values associated with the ecological economics movement, but also firmly based in applied ethics. Subjects covered are philosophy, economics, politics, sociology, geography, anthropology, ecology and other disciplines, which relate to the present and future environment of human beings and other species.

7.7.2 Cultural value

The word "value" means worth. It also refers to an ethical precept on which we base our behaviour. Values are shaped by the culture in which we live and by our experiences. However, there are values that are held high by most cultures. These include fairness and justice, compassion and charity, duties and rights, human species survival and human well-being.

While values guide our behaviour, there are many behaviours to which we grow accustomed because of the society, culture, and conditions in which we live. We may not explicitly examine our environmental values, for example, when we decide whether to live close to or far away from work. Or, perhaps it is more correct to say that we think of more our economic or social environment, comfort, and convenience when we make this choice. Such decision making by large numbers of people has had many serious environmental impacts, such as air pollution from large commuting populations, deterioration of the built environment in cities, and problems of environmental inequities.

7.7.3 Environmental Aesthetics

Environmental aesthetics is a relatively new sub-field of philosophical aesthetics. It arose within analytic aesthetics in the last third of the twentieth century. Prior to its emergence, aesthetics within the analytic tradition was largely concerned with philosophy of art. Environmental aesthetics originated as a reaction to this emphasis, pursuing instead the investigation of the aesthetic appreciation of natural environments. Since its early stages, the scope of environmental aesthetics has broadened to include not simply natural environments but also human and human-influenced ones. At the same time, the discipline has also come to include the examination of that which falls within such environments, giving rise to what is called the aesthetics of everyday life. This area involves the aesthetics of not only more common objects and environments, but also a range of everyday activities.

7.7.4 Recent Developments in Environmental Aesthetics

Since they first took form in the late twentieth century, the basic positions in environmental aesthetics have expanded from their initial focus on natural environments to consider human and human-influenced environments and developed such as to include an aesthetic investigation of everyday life in general. At the same time, the relationship between environmental aesthetics and environmentalism has been increasingly scrutinized, resulting in criticism of earlier work in the aesthetics of nature as well as detailed assessments of contemporary positions. Concerning both the aesthetics of human environments and environmentalism, approaches that combine the resources of both cognitive and non-cognitive points of views have become more common and seem especially fruitful.

7.8 MAN AND ENVIRONMENT

Man and environment are inter-related. The environment influences the life of human beings and also human beings modify their environment as a result of their growth, dispersal, activities, death and decay etc. Thus all living beings including man and their environment are mutually reactive affecting each other in a number of ways and a dynamic equilibrium is possible. Human beings and environment are interdependent.

The different social structures like industrial, agricultural, religious, aesthetic etc. have developed during various stages of human civilization and these structures represent human being's accumulated cultural resources based on natural environment.

The burning issues like quality of environment, disruption of earth's natural ecosystem, environmental degradation and pollution, ecological imbalances, depletion of resources etc. can be approached and solved only after considering the value judgments which may be determined by taking into account the consequences of 'environmental improvement programme' on the entire society. Actually all these depend on the interest and desire of the society in improving the quality of environment.

The interaction between environment and society depends largely on the social and political system. Even the capitalistic and socialistic systems perceptions and reactions to the environment are quite different. The differential interactions are due to uneven distribution of natural resources, uneven economic and social development, dissimilarity of demographic factors, varying view points of the governments and individuals towards environment etc.

Continuous and exceedingly increasing rate of exploitation of natural resources, industrialisation, technological growth, unplanned urbanisation and profit oriented capitalism by the developed western world are responsible for grave environmental crisis and ecological imbalance not confined to their own countries but to the whole world.

The socialistic system of government gives more emphasis on the social importance of natural resources and environmental problems and the urgent need to tackle, these problems. Marxism preaches to organise society's control over the exploitation of natural resources and to develop harmony between man and nature.

The changes in the relationship between man and environment depend upon the change in organisation and attitude of society. To improve environmental standard and to maintain ecological balance, the following are some issues before the present civilized society.

1. Rapid population explosion

Rapid population explosion puts tremendous pressure on the natural resources and environmental quality. This is due to the fact that population growth leads to poverty which directly or indirectly declines the environmental standard.

2. Rational use of non polluted water resources

The restoration of water quality of our water bodies and their optimum uses are the challenges before the present society.

3. To sustain and increase agricultural growth

The over cultivation of soil, results in nutrient deficiency, lack of organic matter, soil salinity and damage to physical structure of the soil. Increase agricultural growth without damaging environmental aspects.

4. To check soil erosion

The soil erosion can be prevented by the restoration of land or soil resources which are directly or indirectly related to strategies for the management of land, water and forest.

5. Restoration of forest resources

The forest resources are depleting at a very faster rate in order to meet growing need of timber and farmland for the increased population. Vast forest areas have been converted into barren waste lands. So it is the need of the present society to restore our forest resources possibly through social forestry and forestation programmes.

6. To check pollution

The over exploitation of natural resources, intervention of bio-geo chemical cycles and trace element cycle, extraneous release of matter and energy etc. cause serious environmental hazards.

In addition, continuous green house gas emission, hazardous chemicals of industry and agriculture, nuclear arsenals; radioactive wastes and biotechnological misuse lead to global catastrophism. So the prevention of pollution is of prime importance for the present society. Considering the above issues, it is clear that the fate of human being depends on how he is managing and overcoming the above problems.

Some possible ways of tackling the problems and maintaining environmental standard

(a) Taking effective measures for population control.

(b) Optimum use of natural resources.

(c) Conserving and protecting biodiversity.

(d) Creating public awareness about the benefits and implications of environment.

(e) Giving top priority for environmental protection.

(f) Developing eco friendly technological processes.

(g) Promoting sustainable agriculture which will not harm the environment.

(h) Using bio-fertiliser or eco friendly fertilisers.

(i) Using minimum amount of pesticides and insecticides.

(j) Developing waste land by adopting forestation programmes.

(k) Developing suitable biotechnology to clean up hazardous wastes in the environment.

(l) Choosing suitable technique to treat the pollutants before their discharge into environment.

Let us see how the process of scientific evaluation is used to solve environmental problems. We will also investigate the steps involved in the scientific evaluation of environmental problems and how they all work together to solve an important issue.

7.8.1 The Process of Scientific Evaluation

Science is more than a set of facts and knowledge; it is a process of asking questions, making observations, and developing experiments to investigate and learn more about a specific topic. Scientific evaluation is very valuable because it makes it possible for us to investigate questions and learn more about the world around us.

Although science can be used to solve many different types of problems, let's examine how scientific evaluation can be used to help solve an environmental problem. Imagine you are walking through the forest, and you notice multiple dead birds. This might alarm you and raise concern about why so many birds are dying in one area. In order to investigate and solve this issue, a scientific evaluation of the environmental problem would be conducted, and it would involve five major steps.

The process starts with scientific assessment and then moves on to environmental risk assessment, public engagement, political action, and ends with long-term environmental management. Although the majority of the true science, based on the definition from the previous section, only takes place in the first two steps, the whole process is referred to as scientific because the science is what lays the foundation for the solution and management of the environmental problem.

7.8.2 Scientific Assessment

The first step in the scientific evaluation of an environmental problem is scientific assessment. Scientific assessment is when information is gathered about the problem through observations and experiments.

In terms of the mysterious bird death example, this step would include the initial observations of the dead birds. It would also include any questions generated by the mysterious deaths and the data collected from experiments conducted to learn more about the cause of the deaths.

7.8.3 Environmental Risk Assessment

The second step in the process would be to conduct an environmental risk assessment, and this would occur after the scientific assessment has found the cause of the problem and after potential solutions are determined. The environmental risk assessment would investigate the potential harm to human health or the environment as a result of the specific problem or the management options.

When related to the mysterious bird death example, there are many aspects to the environmental risk assessment. For this example, let's say the cause of the bird deaths was found to be a rare and deadly fungus growing in the forest. The environmental risk assessment would first be done to determine what would happen to the remaining birds and other organisms, including humans, if the fungus was not removed.

Secondly, the environmental risk assessment would examine the possible removal solutions for the fungus and determine the potential harm caused by each solution. The estimated harm caused by leaving the fungus would then be compared to the potential harm caused by the removal solutions to determine the overall risk of both possible outcomes to the problem.

7.8.4 Public Engagement

After the cause of the environmental problem has been determined and the risks associated with each outcome have been assessed, it is important to get the public involved. The third step in the scientific evaluation of an environmental problem is public engagement. Public engagement is when citizens are informed about the environmental problem and presented with the potential solutions and risks associated with the problem.

Public engagement is very important to this overall process because it is the step where more people become informed and can take action to make sure something is done about the problem. In some cases, this leads to public demonstrations to raise awareness, or citizens voicing their opinion on how the issue should be handled to their local politicians and governing agencies.

For the mysterious bird death example, this is the step when the public would be informed about the bird deaths, the fungus that is causing the deaths, the proposed solutions, and the risks associated. This is when people would voice their opinions on which proposed solution should be implemented to remove the fungus, or they may advocate to leave the fungus alone and let nature takes its course.

7.9 PUBLIC KNOWLEDGE OF ECOLOGY

The idea of public ecology has recently emerged in response to increasing disparities over political, social, and environmental concerns. Of particular interest are the processes that generate, evaluate and apply knowledge in political, social, and environmental arenas. Public ecology offers a way of framing sustainability problems, community dynamics and social issues. Forests, watersheds, parks, flora, fauna, air, and water all constitute environmental quality and are therefore public goods. The processes society engages in to negotiate the meaning of these goods, upon which decisions and actions are based, reside within the public domain.

The Ecology of Democracy fully captures these emerging insights of centers for public life in ways that underscore and illuminate the powerful potential of these civic efforts. It will spark fresh thinking and sharpen insights among those who have been trying to strengthen connections between the formal, institutional structures in their communities and the organic, informal work of citizens. It challenges centers for public life to move beyond the familiar terrain of naming, framing, and deliberating public issues into the less tangible, but ultimately more impactful, democratic practices of working in communities to move from public dialogue to community-based action.

On a foundational level, civic innovators who create centers for public life understand that public knowledge is socially constructed; they believe that self-rule requires self-organizing; they realize that connectivity is more important than scale; they demonstrate that owning a problem is a potent source of energy for civic work. As practitioners, they help create public space to make public choices; they make powerful connections with the things people care about. Their work illustrates the belief that “the best strategy for combating the rampant loss of confidence and legitimacy in institutions may be in strengthening civic agency.” They attempt to

strengthen civic agency in a myriad of ways, most focused on embedding habits of public participation and on impacting the quality of public life in their communities.

7.9.1 Rights and responsibilities in ecology understanding

Environmental Risk Assessment (ERA) is a process that evaluates the likelihood or probability that adverse effects may occur to environmental values, as a result of human activities. Acting responsibly with regard to the environment is part of our corporate culture. We are committed to sustainable action toward the environment and future generations.

7.9.2 Environmental Responsibility

Environmental responsibility is one of such aspects of our life that most people are aware of, but tend to ignore at some level of consciousness. Of course, there are activists who voice their concern and try to change this world for the better, making it more nature-friendly, but the number of such people is still too little to make a difference. So, what do we need to change the situation?

One of the main problems is the people's attitude towards the problem itself. People know that if they *litter, use cars* and *sprays*, they pollute the air and environment. But they continue to do it. "Many people" will not stop doing it along with them, so on the whole the situation will still be bad.

We apply the necessary effort to change people's attitude towards the problem, and will show them that, the situation will become much better. People will start changing their behavior, each of them making a considerable contribution to the health of our planet**.**

Check Your Progress – 3

Note: a) Space is given below for your answer

b) Compare your answer with those given at the end of this unit

9. In environmental resource management the ---------- is responsible for administering natural resource management and implementing environmental production legislation.

10. The private sector's traditional role in environmental resource management is that of the recovery of----------.

11. The word "value" means ----------.

12. Give any two ways of tackling the problems and maintaining environmental standard**.**

7.10 LET US SUM UP

In this unit you have learnt in detail about the environmental resource management. You have understand the global early warning systems for natural hazards, need for integrated system for early warning, meaning of society, culture ,and environment. Man and environment, environmental values, environmental aesthetics, cultural values are also learnt by you in detail. Hope you might have realized the urgent need for the researches on resources management of environment.

7.11 EVALUATION

1. What is Environmental resource management ?
2. What is the significance of Environmental resource management ?
3. What is Environmental monitoring ?
4. What is Air quality monitoring ?
5. What is Global Early warning systems ?
6. What is Environmental values ?

7. What is Cultural values ?
8. What is Environmental aesthetics ?

UNIT-END ACTIVITIES

Describe the way in which you can develop a favourable attitude among your learners towards environmental monitoring.

POINTS FOR DISCUSSION

'Obtaining knowledge on environmental values is a beginning not an end' - discuss

ANSWER TO CHECK YOUR PROGRESS

1. non-living.
2. Provides a systematic way of managing an organization's environmental affairs.
   EMS assists with planning, controlling and monitoring policies in an organization.
3. (ISO) 14001.
4. waste.
5. 6000.
6. Risk knowledge.
7. Scientific knowledge.
8. Knowledge base.
9. Public sector.
10. natural resources.
11. worth.
12. Optimum use of natural resources.
    Conserving and protecting biodiversity.

SUGGESTED READINGS

1. Pannerselvam, A and Mohana Ramakrishnan “Environmental science education” Sterling publication, New Delhi. (2005).
2. Nagarajan and Sivakumar.P “Environmental Education”, Ram Publishers, Chennai.(2002).
3. Veera Bala Rastogi and Jayaraj “Animal ecology and distribution of animals”, Kedar Nath Ram nath, New Delhi. (1984).
4. Lewis, Geraid E. “A Review of Classroom methodologies for environmental education”, The journal of environmental education, (1982).
5. Lange, Robert R. “Environmental Education Needs Assessment and Evaluation”, Colorado. (1980).