Environmental History of India

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Environmental History of India

Unit - I

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UNIT - I

Lesson 1.1 - Environment – Factors and Resources

Structure

1.1 Learning Objectives

The main objectives of this unit are

1. To summarize the meaning and importance of environment and ecology
2. To learn the importance of various resources and its conservation
3. To understand the multidisciplinary nature of environmental studies
4. To comprehend the need of sustainable usage of the resources
5. To realize the ill effects of the over usage of the natural resources

Key Words: Environment, ecology, environmental studies, natural resources, sustainable development, over utilization of resources.

1.2 Introduction

Environment is defined as the totality of all the resources that enable an organism to flourish. The word environment is derived from the French term "Environ" which means 'surrounding'. The earth on which we live has several components that provide us these surroundings for life to thrive on it. Thus, the total of all the resources that we have on planet earth is the environment that surrounds us and makes life possible. The environment in which we live in i.e., the air we breathe, the water we consume, the land that we use along with the other living beings like plants, animals and birds influence each other. The two major components of the environment are biotic elements and abiotic elements. The living organisms are called the biotic elements, such as birds, animals, plants, forests, fisheries etc., whereas, the abiotic elements are the air, water, land, rock, sun, etc. The biotic and abiotic elements depend on each other and thus are interdependent for making life possible on planet earth.

An ecosystem refers to all the biotic and abiotic elements present in the environment. The term 'Ecosystem' was coined by an English Botanist, A.G. Tansley in 1935. It is a system where the living organisms interact with each other and the surrounding environment. It is a chain of interactions. The two major types of an ecosystem are Natural ecosystem (Deserts, Forests, lakes, mountains oceans, etc.) and Artificial Ecosystem (fields, gardens, parks, zoo etc.). The structure of an ecosystem depends on the following conditions:

a. The composition of the biotic community – the type of species, their distribution and the rate at which they are present.
b. The distribution of the abiotic elements - water, minerals, soil etc.,
c. The external factors like temperature, humidity, rainfall, wind etc.,

The composition of living and non-living systems constitutes the building blocks of an ecosystem. Each component in an ecosystem has its own properties and a significant role in maintain the structure of the system. The interaction between the elements of an ecosystem is very delicate and subtle and the impact of a single change in the form of interaction between the elements can never be predicted.

Earth is a home to several living organisms which are interdependent on each other for their growth and survival. All living beings need air to breathe, land to live, food to eat all these are given to us by the environment

in which we live. Environment plays a very important role in existence of life on earth. It is interwoven into the daily life of human species and thus it is the responsibility of human beings to take care in preserving and conserving the environment so that life can continue on earth. Many activities of man has resulted in destroying the environment around us and causing several disasters leading to loss of life and property.

1.3 Factors Impacting the Environment

Amenta and Elliot define environmental factors as, "the external factors that impact human behaviour and decision-making. These factors include physical, social, cultural and economic factors, as well as broader structural conditions such as political systems, institutional arrangements and historical legacies." The environmental factors thus are the natural and socio-economic conditions in which humans interact with each other. The following are some examples of environmental factors are climate, population, natural resources, economic systems etc.

There are four major categories of environmental factors:

a) Abiotic Factors: The resources that are required by organisms to grow, sustain and reproduce are termed as the abiotic or physical factors. These are the abiotic components of the environment. They are non-living factors. Factors such as sunshine, light, humidity, availability of water, soil composition, temperature etc. are classified as abiotic factors.

b) Biotic Factors: These factors include the living component of an ecosystem.They are biological factors. Organism interact with each other and enable to sustain life. These factors can further be grouped under three categories –Producers, Consumers and Decomposers.

Producers – These are also known as **autotrophs.** They are organisms which derive energy from abiotic components and convert them into food. The best example is that of Photosynthesis. In this process, plants absorb energy from sunlight, nutrients from water and carbon dioxide. They convert this into food (glucose) and grow. They also give out oxygen. Thus, plants are the primary producers in the environment.

Consumers – These are the **heterotrophs**, which obtain energy from the producers and other consumers. Animals are the most common form of heterotrophs. Consumers which feed only on producers (plants) are called

as **herbivores** (ex. Cattles), those which feed on other consumers are known as **carnivores** (ex. wolves) and those which consume both producers and consumers are called as **omnivores** (ex. Bears).

Decomposers – These help in maintaining the balance in the environment. They break down the chemicals created by producers and consumers into simple molecules and enable it to be absorbed back into the ecosystem. They are most important part of the biotic factor as they help to decompose the biotic factors and transform it into another form of resource. The products made by the decomposers are used by the producers to absorb nutrients. Examples of Decomposers are Fungi, earthworms, etc.

c) Economic Factors: The demand of the growing population, the need to fulfil the socio-economic needs such as providing employment, source of income, trade etc., all contribute to the economic factors. These factors determine the rate at which the environment is protected and exploited for economic reasons.

d) Aesthetic Factors: These are factors which contribute to sustaining an environment. Protectiing the environment for its aesthetic sense, to realize its beauty and tranquility, to conserve its rich historical and cultural legacy in forms of architectural or archaeological sites or maintain regions for understanding its landscape in more scientific approach (bio-reserves) all contribute to the aesthetic factors of the environment.

1.4 Ecology

Ecology refers to the study of structure and functions of nature. The word Ecology is derived from the Greek word, 'Oikos' which means habitation and 'logos' which means study. Thus, ecology means the study of the habitations of an organism. In 1866, German zoologist, Ernst Haeckel coined the word oeckologie, which was meant to refer to 'the relation of animal to its organic as well as inorganic environment, particularly its friendly or hostile relations to those animals or plants with which it comes in contact.' Ecology is a distinct branch of science, which focuses on the study of natural systems, of which, the biosphere is the largest system consisting of Terrestrial and Aquatic systems. All the ecosystems if the earth constitute the biosphere. The part of the earth where life exists is termed as Biosphere. It comprises of the lower layer of the earth's atmosphere, the oceans and freshwater and the outer layer of the earth's crust. Ecology tries to understand the distribution of biotic and

abiotic factors impacting living organisms in the environment. The Biotic components of an ecosystem are the living factors, example, bacteria, animals, birds, fungi, plants, etc. Whereas the Abiotic components are the non-living physical and chemical factors which can be acquired from the atmosphere (air), lithosphere (land) and hydrosphere (water).

The classification of Ecology is done on the basis of the level of interaction as follows:

Landscape Ecology: The study of the impact of human kind on the landscape structures and its functions.

Ecosystem Ecology: This refers to the study of living and non-living components and their relationship with the environment.

Community Ecology: This branch of study refers to understanding an ecological community which is made up of two or more populations of different species living in a particular geographical area. It attempts to understand the modifications on a community structure by the interactions among living organisms.

Population Ecology: Population is defined as a set of individuals of the amae species living in a given place at a given time. In this branch of ecology, the fluctuations in the size of the population and its interactions with the environment is dealt with. It examines the population density and distribution. This will enable to determine the danger to a particular species or the increasing number of any species and the exact measure of resources available.

Significance of Ecology:

The environment that we live in is a delicate balance of several biotic and abiotic elements. Ecology gives the understanding of the impact of human action on the environment. The extent of damage done to the environment can be assessed through the study of ecology. This knowledge will enable us to take measures to **conserve the environment** and preserve it form further degradation. The lack of understanding ecology has led toe the extinction of several species and many more have become endangered ones.

Further, through ecology we can understand the availability of resources. One of the characteristic features of resource is its uneven distribution. Over utilization of resources leads to scarcity and deprivation of resources. This knowledge will enable more clarity on **resource**

allocation. Proper understanding of ecological requirements prevents unnecessary wastage of energy resource, this will allow conserving energy for future purposes. Moreover, this knowledge encourages **harmonious living** within the ecosystem and **protects the environment.**

1.5 Functions of an Environment

The four major functions that the environment performs are –

1. Supply of Resources – These are of two types, renewable and non-renewable resources. Renewable resources are those which can be replenished after utilization. Example forest resources and water resources. Non-renewable resources are those which will become exhausted after their utilization. Example Fossil Fuels.
2. Sustains life – With the support of the resources, environment enables to sustain life on earth. It provides genetic and biodiversity.
3. Assimilates waste
4. Provides aesthetic values, Example – scenery

Environment can perform these functions without any human intervention. There should be synchronization between the rate of demand on the environment and the rate of replenishment. As long as the environment can meet these demands and get replenished the balance in the elements of the environment will be maintained. If the demand on the environment is within the carrying capacity its functions will not be disrupted. The rate of resource extraction should be not be above the rate of regeneration. If this fails the environment will fail to sustain life leading to environmental crises. In the present-day context, we are facing this hazard. The major cause for this crisis is population explosion. This triggers a chain of activities which puts a heavy strain on the environment. Increasing population means increasing demand for land resources, food supply, economic activities and energy resources. Strain on one resource will lead to pressure on all resources ultimately leading to the exploitation of resources. Over utilization of resources, polluting the available sources and making it unusable and exhausting of vital non-renewable resources have disrupted the **Absorptive Capacity** of the environment and made it impossible for the environment to absorb degradation of environment.

The degradation of environment has led to serious environmental issues such as depletion of the ozone layer and global warming. Ozone layer found in the stratosphere absorbs the harmful ultra violet rays of the

sun from reaching the earth. These rays cause serious health hazards like skin cancers and affect the growth of aquatic and terrestrial organisms. Due to human intervention and overutilization of natural resources, the high levels of chlorine and bromine compounds are released into the stratosphere which leads to the depletion of the ozone layer. These compounds are found in Chlorofluorocarbons (CFCs - which are used as cooling substances in air conditioners and refrigerators), aerosol propellants and bromofluorocarbons (used in fire extinguishers). Thus, the depletion of the ozone layer is a serious crisis and has to be dealt with great responsibility. Global warming, refers to the gradual increase in the temperature of the earth's atmosphere. This is a phenomenon since the beginning of the industrial revolution. Due to this human activity the percentage of carbon dioxide released into the atmosphere is more than that can be absorbed by the environment. As a result, the composition of carbon di-oxide increases making the planet mor warmer. As of May 2022, the average concentration of CO2 in the atmosphere was 421 ppm (0.04%). This denotes 50% increase since the beginning of the Industrial Revolution. The major reason for global warming is burning of fossil fuels (coal and petroleum) coupled with deforestation. Production of methane is also a contributor to global warming. The impact of global warming leads to rise in global temperature. This melts the polar ice caps, leading to rise in sea levels, coastal flooding, disruption of drinking water, extinction of living species, tropical storms and increase of tropical diseases.

It is evident that environment and economy are interdependent on each other. Development has to take place while being mindful of the environment. Thus, sustainable development is needed to help sustain life on earth and conserve the environment. The United Nations Conference on Environment and Development (UNCED) defines sustainable development as, "Development that meets the need of the present generation without compromising the ability of the future generations to meet their own needs".

In India, developmental activities have added to the immense pressure on the finite resources of the country. Over explosion of population, affluent composition and production have placed a huge stress on the environment. They not only exhaust the resources, but also cause serious health hazards. India faces two forms of dangers with regards to environmental issues. One environment degradation, due to growing population and a struggle to take care of the demands of the teeming

millions and the other is danger of pollution which is a great concern and rapidly destroying the natural resources

1.6 Environmental Studies – Nature and Scope

Environmental Science is an inter-disciplinary study that deals with the interaction of a human kind with the biotic and abiotic components in the environment. The branch of study that deals with the study of atmosphere, lithosphere, hydrosphere and the physical and chemical changes that occur due to the interaction between these three realms in the biosphere is called as Environmental Studies. Environmental Scientist, Newman defines Environmental Science as the branch of science which studies the processes which occurs in water, soil, air and living organisms. This process creates harmful effects and impacts the flow of energy leading to problems in the environment. Environmental studies attempt to find solutions to handle the problems impacting the environment – its structure and functions. Due to the growth in population, there is a strain on the natural resources to fulfill the necessities and meet the socio-economic demands of the nation. Progress of civilization, development in science and technology and increase in the demand for luxurious life style is adding to the already complex issue of environmental sustainability. In the light of this situation, it is important to understand the scope of environmental studies.

The scope for environmental studies are as follows:

a) This study helps us to understand the richness of the biodiversity that exists around us and the need to conserve and preserve it.

b) It provides sufficient knowledge about natural and man-made ecological systems, the flow of energy it and the impact that human interaction has on the system.

c) It helps to create awareness of the available natural resources in a geographical region, its distribution and how it can be shared with other regions. Since the feature of natural resource is that it is unevenly distributed, organised mechanism has to be in place to share the resource with all the regions so that it is profitable to all. This has to be done in a sustainable manner to avoid this resource from getting exhausted. Environmental studies help to create an awareness in this regard to be aware of the resources and appreciate its benefits.

d) This study enables us to understand the causes for the harmful effect on the environment, the consequences of human interaction and how it can be controlled. Due to this several disasters occur. This study also helps us to understand the nature of these disasters, their causes and their consequences.

e) The major problem that the countries of the world are facing is that of over population, which is the reason for most of the environmental issues. Environmental studies focus on this problem, the associated issues that arise out of it and the measures to curb these problems.

f) Sustainable development is the only answer to the challenges that environment is facing at present. This study will create avenues to discuss methods for sustainable development which will enable us to conserve our environment and preserve our resources.

1.7 Multi-disciplinary Nature of Environmental Studies

The term multidisciplinary refers to the combination two or more branches of study. When an area of study involves multi-sectoral and multi-dimensional research in a variety of disciplines, it is termed as multi-disciplinary. The environmental changes taking place around us are so intense and critical that it requires a multidimensional approach to understand the impacts and act quickly to preserve what is left of the fast-degrading environment. It requires specific skills and expertise to understand the intensity of the issue, its global impact and the irreversible changes that are being impacted on our surroundings. This makes environmental study a vast field, encompassing various elements of Physics, Chemistry, Geography, Biology, Agriculture, Statistics and many more.

This study attempts to understand several aspects, their causes and consequence. For example, this study emphasis the need to understand:

- Biodiversity – Types of biodiversity, how it has changed, the causes for its change, are the changes reversible, etc.,
- Pollution- Various types of pollution, the causes for the pollution, its harmful effects, how to combat this problem, creating awareness, etc.
- Deforestation – Causes for deforestation, methods to prevent it, awareness on afforestation, etc.
- Problems of desertification, waste disposal, sewage treatment, etc.

These are examples of some of the areas that environmental study aims to deal with. This clearly indicates the multi-disciplinary aspect of this branch of science.

Components of Environmental Study

Environmental study (EVS) is not a single phenomenon. It deals with several components. These components are the other branches of study which enable environmental study. Some of the components are discussed here.

Anthropology: This is the study of human traits, social, psychological, biological well-being of communities and cultures, the growth and evolution of human species and so on. EVS depends on this branch of study since it deals with interaction between human species and their environment in various phases of time.

Sociology: This deals with study of social life, changes in the society, causes and consequences of human actions. It helps environmental scientists to identify social practices that create an impact on environment and ways to deal with it.

Geology: The study of earth's physical structure, its formation, composition and features comprise of Geology. EVS depends on this branch of study to understand various natural resources, their concentration, distribution and the rate at which they are being depleted.

Geography: This branch of science deals with the natural and man-made physical features in all the spheres. It concentrates on the interaction that takes place between the biotic and abiotic components in the biosphere. This is very closely related to EVS as the field of research is the same.

Biology: This focuses on the study of living creatures. The evolution of various species, their physical structure, chemical composition, the interaction at various levels is dealt in this branch of science. This is closely related to EVS as it concerns with the natural environment of living creatures.

Chemistry: EVS requires the knowledge of the chemical composition of various matter in the environment. Chemistry, is a branch of science which enables to examine the chemical components of various resources.
Physics: This branch of science examines flow of energy, interaction of matter in space and time. Physics deals with energy conservation,

understanding the changes in the various strata of the atmosphere and other environmental issues.

Economics: This branch of study deals with modes of production, patterns of consumption, resource allocation and distribution of commodities and services. Economic progress requires several developmental projects and infrastructural growth. These are often times accompanied with lot of impact on the environment. EVS will help to form economic strategies which will aim at progress combined with methods to preserve the environment from harmful effects like pollution, global warming, climate change and other environmental concerns.

Statistics: This refers to the study of quantitative data. It requires data collection, analysis, interpretation and presentation. EVS relies heavily on statistics to understand the quantity of natural resources. This will enable scientists and policy makers to make a sustainable use of the available resource and preserve them from being exhausted.

The challenges that our environment is facing are very complex in nature and needs a multi-disciplinary approach to understand them. The use of modern technology such as artificial intelligence will enable to collection of data through remote sensors to achieve a comprehensive view of the problem, apply modelling tools and statistical analysis to arrive at attainable solutions using Geographic Information System (GIS)

1.8 Importance of Environment Studies

Environment Studies involves physical science, life science and social science. A complete understanding of all the branches of study is required to understand the different aspects of the environment. The scope of this branch of study is very wide and covers aspects of almost every major discipline. The environment we live in provides us with plenty of resources to fulfill our basic needs and also to achieve economic progress. The environment has its own way of replenishing the resources, but the rate of extraction must be within the carrying capacity. If this capacity is exceeded, it tends to over utilization of resources, leading to depletion. This extremely important dynamics of the natural resources has to be understood by all and at all levels. It is not only the responsibility of the Government to take care of the resources and enact legislations to preserve it, but the duty of every single individual to contribute their share in protecting the environment. The phrase, "Think globally, Act locally"

is apt in this context. EVS enables us to understand the challenges faced by the environment at a global level, we have to comprehend it and make individual choices to act locally to preserve and conserve our environment. This begins from our homes. Practices such as, not to waste drinking water, not to dump wastes in the open, not to waste paper irresponsible, might seem very simple, but has great impact if everyone practices it consciously. This is the aim of EVS.

The driving principles of Environment Studies are as follow:

- To understand environment in its totality – natural, man-made, socioeconomic, political, cultural, historic, technological as well as aesthetic forms
- To understand the multidisciplinary approach of EVS
- To examine the environmental issues from local, regional, national and international view.
- To understand the current potential of natural resources and consider environmental aspects for economic growth and developmental projects
- To comprehend the seriousness of the challenges facing the environment and develop critical thinking and problem-solving skills.
- To enable the learners to discover the causes for issues facing the environment and seek solutions for the same
- To emphasise active participation in planning to enable sustainable development and prevention of pollution at all levels.

Thus, Environmental Studies are important to:

Create Awareness – About the issues and challenges facing the environment

Disseminate Knowledge – On the various causes, consequences of human interaction and its impact on the environment

Sensitize – on the ways and means to protect and conserve our natural resources

Acquire Skills – to identify and act on various aspects impacting our surroundings

Participate – in every way possible to contribute our share in preserving our environment.

1.9 Natural Resources

We are surrounded by variety of resources provided naturally by our environment which are necessary for our daily life. These are termed as Natural resources. Natural Resource is defined as a form of energy and/or matter which is essential for the functioning of organisms, populations and ecosystems. Natural resources are assets, which are found in the nature and are generally useful for economic production and consumption. They are sources that exist naturally on the planet and are independent of human intervention for their origin or production. There are plenty of natural resources around us that occur naturally, like land, water, soil, flora, fauna, minerals (especially fossil fuels) and forest resources. The very term natural resources suggest that they provide the basis for life on earth. They are the naturally useful to the human species (ex. Air, water) or can be made into useful products with the use of technology (ex. Metals, geothermal power). In the process of evolution of mankind, when humans where in the hunter-gatherer stage, they completely depended on their survival on the natural resources available to them in plenty. About ten thousand years ago, when human species evolved from a huntergatherer stage into settlements, they started to fashion the environment to suit to their requirements. Thus, they became agriculturalists and pastoralists. Since then, beginning from use of simple hand-held tools to the latest development of launching satellites to the moon, human being is completely dependent on natural resources for survival as well as economic development and progress. Hence, natural resources, refer to any form of energy or matter essential for the fulfillment of physiological, socio-economic and cultural needs, both at the individual level and that of the community.

1.10 Classification and Types of Natural Resources

Ecosystems act as the producer and processor of the resources. Energy derived from sun or solar energy provides the needed energy which grows and sustains life on earth. Natural Resources can be classified under the following types:

A. Classification based on their availability

Natural Resources are broadly classified into two types – Renewable Resources and Non-Renewable Resources. This classification is done on the basis of their availability or renewability.

1. Renewable Resources: The resources which are available in infinite quantity and can be repeatedly used, because of their inexhaustible nature are termed as Renewable Resources. They are consistently available and can be renewed after utilization. They can be replenished through rapid natural cycles. Examples of renewable resources include air, wind, water and sunlight. These are inorganic renewable resources. Organic resources like forest resource, vegetation are also renewable resources. They are sources of renewable raw materials. Though termed as renewable resources, they can be renewable only within certain limits as they are linked to natural cycles. Some forms of renewable resources can be recycled. For example, wood, rubber, leather.

2. Non-Renewable Resources: The resources which cannot be substituted or recovered once they are utilized or destroyed. These resources would take millions of years for their formation. Though they are also formed naturally, their formation is very long and slow process. They are formed in the lithosphere and constitute a closed system. Fossil fuels and minerals are the best examples of nonrenewable resources. Since fossil fuels are formed from living things, they are also known as organic non-renewable resources and other resources which are from rocks and soils are referred to as inorganic non-renewable resources. These resources cannot be replenished through natural processes. Unless these resources can be recycled by sustainable usage, they will be completely depleted. Non-renewable resources can be further divided into two categories – recyclable resources and non-recyclable resources.

Recyclable resources are those types of non-renewable resources which can be recycled after they have been used. They are mostly non-energy mineral resources occurring on the earth's crust (e.g. ores of aluminum, copper, mercury etc.) and minerals in their natural state (e.g. asbestos, clay mica etc.). Whereas, non-recyclable non-renewable resources are all other forms of resources which cannot be recycled at any stage (e.g. fossil fuel, uranium, etc.).

B. Classification based on the source of origin:

On the basis of the source of their origin natural resources can be classified into two categories:

1. Biotic Resources
2. Abiotic Resources

Biotic Resources: The natural resources that originate from organic and living materials are classified as Biotic Natural Resources. Animals, forest resources and materials that are obtained from them constitute Biotic Resources. Fossil fuels can also be included in this classification as they are obtained from decayed organic matter.

Abiotic Resources: The natural resources obtained from non-organic and nonliving materials are classified as Abiotic resources. Land, air, water and metals like copper, gold etc., are Abiotic Resources.

C. Classification based on the stage of the development of the resource:

1. Potential Resource
2. Actual Resource
3. Reserve Resource
4. Stock Resource

Potential Resource: The resources that are already easily available for use, but their potential is not yet optimized, such resources are called as potential resources. For example, wind and solar power are two such resources. Though we are using these resources, we are yet to understand their full potential.

Actual Resource: The resources which have been discovered, developed and used by humans over a long period of time are Actual Resources. Their extent, their availability and their potential for use has been understood by mankind and has been helpful in the progress of civilization. Most of the natural resources fit into this category. For example, water, fossil fuels, minerals, flora and fauna are such resources. These resources are developed and made consumable with the help of technology.

Reserve Resource: Resources which can be stored for future use are known as Reserve Resources. Such as storing water in a dam for meeting energy requirements or for domestic purposes is one example.

Stock Resource: The resources for which the required technology to extract them is still not in practice are known as Stock Resource. For example, the extraction of energy from hydrogen and oxygen in water.

Characteristic Features of Natural Resources:

As discussed in the above passages, natural resources are very essential for sustenance of human life on earth. These resources have the following characteristic features:

1. Natural resources are gifts from the nature and hence are common properties for the betterment of mankind.
2. The distribution of natural resources is uneven in nature and hence leads to monopoly of certain regions.
3. Renewable resources have to be used in a sustainable manner to avoid depletion of resources.
4. They are an integral part of the environment. An adverse impact on the resources will in turn bring adverse impact on the planet. Example, Destruction of forest cover will lead to destructive floods.
5. The natural resources are destroyed or consumed in the process of use. This leads to problems like desertification and aridization.
6. Destruction of natural resources will ultimately lead to extinction of species on earth as life is not possible without the presence of these resources.

1.11 Forest Resources

One of the most important renewable resources are the Forest Resources. Trees, shrubs and herbs form the major part of the forest. They are home to numerous species of birds, animals, reptiles and insects. They are a production house of varied number of products and provide food for living organisms and form a very essential part in the sustenance of the environment. They are a major contributor to the economic development of any country. It is estimated that 30% of the total area across the world is covered by forests and 26% by pastures. Africa has the largest forested area of 33% followed by Latin America with 25%. Asia and USSR (formerly) have 14% and North America has a coverage of 11%. European countries account for only 3% of forest coverage. As of 2005, India accounted for 20.6% of forest coverage.

Uses/ Functions of Forests:

1. Productive Function: They provide the raw material for various industries. For example, pulp for paper industry, resources for pharmaceutical industries, wood for timber industry, lac for rubber industry. Hence, they are the basis on which several industries function.

2. Protective Function: These are also areas where several species of birds, animals, reptiles and insects find shelter. The forest protects them, gives them food and a conducive environment to live and flourish. Also, the

forests protect the soil cover from erosion, replenishes the soil and helps to prevent drought and famine.

3. Regulatory Function: The most important function of the forests is to regulate the environment and maintain the equilibrium. For example, regulation of Carbon di-oxide (CO2), Oxygen (O2), water (H2O) and minerals are possible because of the presence of forests and give us a healthy and clean environment. In the presence of forests, CO2 is absorbed and O2 is released which maintains the equilibrium in the environment and helps reduce the global temperature.

Significance of Forests:

Forests are a major resource for the existence of life on earth. Its significance are as follows:

1. Commercial Significance: These are the major source for many commercial products. They are the energy source for about 1.5 billion people who depend on forests for fuel from firewood. Timber from forests are the raw material for several products like furniture, paper, agriculture implements and sports goods. They are also raw material for food, fibre, edible oils. The forest lands are used for agriculture and grazing, thus supporting the rural population and dairy industry. Forests are also major store house for minerals.

2. Ecological Significance: Numerous species of plants, animals, reptiles and insects have the forests as their habitat. They are the most important part of the ecological system. They help in reducing green house gases and aid in the production of oxygen, thus reducing global warming. They are a natural purifier as they absorb toxic gases and provide clean and pure oxygen to breathe. They help to conserve the soil from erosion and thus assist in the hydrological cycle.

3. Aesthetic Significance: Forests have a great aesthetic value. They provide space for recreation and also research. Human kind appreciates the forests for its beauty and tranquility.

4. Tribal community: Forests are also homes for several tribal communities. They practice very primitive ways of living. They depend on forests for their life and economy. They are also protectors of the Forest Resources.

Exploitation of the Forest Resource:

It is evident from the above passages, that forests are an important resource and also a major contributor to the economy. As civilization has progressed, human kind has developed in all major aspects with the help of science and technology. Since the beginning of the 20th century, several factors have contributed towards the exploitation of the forest resources. One of the major factors is population explosion. Due to increase in population the natural resources available in the forests in plenty is being depleted at a very faster rate. Forest covers are vanishing in almost every continent. Large tracts of forests are being cleared to make space for the ever-growing population. The increase in demand for forest products and expansion of area under urban development and industries has eventually led to the over exploitation of forests. This is turn destroys the soil which is being protected by the forests, leading to floods, famines and forest fires. It leads to loss of several species of flora and fauna categorizing many of them as endangered species some also becoming extinct.

According to the recommendations of the National Forest Act, 1988, 33% of the total land area and 67% of hilly areas must be preserved under forest cover for sustainable development. At present, we are losing forests at the rate of 1.7 crore hectares annually in the international level. Destroying of forests for short term benefits, will only lead to permanent loss of the natural resource.

Deforestation:

Loss of forest coverage is termed as Deforestation. There are several reasons for the loss of forest cover. Forests are the producers of a variety of resources that are necessary for human consumption. Yet, overuse of these resources leads to the exploitation of the forests and in the present context it is the overexploitation of the resources. This is the main cause for deforestation. Forests are being cleared at an alarming rate for timber, land, agriculture, expansion of cities and developmental projects. In temperate countries deforestation takes place at a relatively low rate (1%), but in tropical countries deforestation takes place at a very rapid rate (40%). At this rate, we are at the danger of losing the tropical forests in a few decades from now. India has only 20.6% under forest cover and this is declining at a very faster rate, whereas the expected coverage is 33%.

Causes for deforestation:

1. Overpopulation has several harmful effects of which a primary effect is deforestation. Due to the increase in population forest lands have to be cleared for dwelling and agricultural purposes.
2. Shifting cultivation is major practice in forest area. This involves the practice of slash and burn. In this process large areas of land are rendered uncultivable and become fallow. It is the principal cause for deforestation in tropical regions. In India, it accounts as a major contributor to deforestation as shifting cultivation is widely prevalent in the north east and to a large extent in Madhya Pradesh, Bihar and Andhra Pradesh.
3. Increase in population, leads to an increase in the demand for fuel and it amounts again to deforestation.
4. Cash crops generate revenue and so forest lands are cleared to grow cash crops. In the long run, this also amounts to deforestation.
5. Large scale development projects are initiated by the governments for meeting the requirement of the population. There is an ever-increasing demand for electricity, water, mineral, etc. These development projects require large areas of land and plenty of resources. This has adverse effect on the environment, leading to deforestation, loss of habitat for the forest species and displacement of the local communities.

Consequences of deforestation:

Deforestation has adverse effects and directly impacts and damages the environment and the living beings in it. The following are the adverse effects of deforestation:

1. The primary effect is soil erosion. Soil loses its fertility and becomes uncultivable.
2. Floods are a common occurrence and makes the region barren, ultimately leading to famine and drought.
3. Reduction in rainfall occurs due to the impact on the hydrological cycle.
4. Loss of the forest biodiversity, the flora and the fauna.
5. Desertification takes place at an unprecedented pace.
6. Global warming increases, climate change and depleting water table are all effects of deforestation.

Conservation of Forests:

One of the most valuable resources which is an ecosystem in itself is the Forest. Destroying of forests, will eventually destroy the planet. Measures have to be taken to conserve this resource and hand it over to the coming generations. The following steps should be implemented to conserve this resource:

1. Forests are a national resource, thus the government along with the support of the people must endeavor to protect this most important resource by creating the needed awareness and supportive legislations for the same.

2. Local communities and tribal groups must be given the priority in protecting this resource, as it is their home and they belong to it.

3. Afforestation campaigns must be launched effectively and the general public must be involved in it.

4. Planting of trees in surrounding areas, fallow lands, around cultivable lands, river banks, along the roads, institutional campuses should be encouraged with the support of the government and NGOs.

5. Recycling of products made from forest resources such as paper, furniture etc., will help to minimize the cutting of trees.

6. Forest fires should be prevented through constant monitoring.

7. Over grazing of forest lands should be avoided and grasslands should be regenerated.

8. Forest Conservation Act should be strictly implemented to manage and conserve the forest resource.

India has witnessed several movements by the local population to protect the forests from deforestation. One such movement was the Chipko Movement in 1970s. This was a non-violent, social and environmental movement led by the rural Indian peasants, especially women to prevent the felling of trees in Uttrakhand (then part of UP). The people employed a strategy of tree-embracing to prevent loggers from felling the trees and thus the movement got the name 'Chipko'. The objectives of the movement where to conserve the natural resource (trees), protect the ecosystem, strive for socio-economic justice, create ecological awareness through non-violent resistance and encourage sustainable development. Environmental activists like Sunderlal Bahuguna and Chandi Prasad Bhatt were instrumental in creating awareness and mobilizing local communities to participate in this movement.

1.12: Water Resources

Water – an elixir of life, is a renewable and indispensable natural resource. About 70% of the earth surface is covered by water. Of this 97% is not fit for human consumption (in form of sea/ocean water), about 2% is locked up as glaciers and less than 1% only is available for use. Water has several unique characteristics. It is very essential for human survival as it is an excellent solvent and acts as a nutrient carrier which distributes nutrients to the cells of the body. It regulates the body temperature. It is the major part of the hydrological cycle. Water evaporates from the earth and returns in the form of rain through the hydrological cycle. It is an indispensable resource and essential for life to exist on earth. It is a renewable resource, but overuse and pollution render it unfit for consumption.

Uses of Water Resources:

Water is used for a variety of purposes. As discussed earlier, only 1% of water is available in consumable form. This resource is used in the following manner:

1. Domestic Use: This includes drinking, cleaning, personal hygiene, cooking etc. As the population is ever expanding, there is more pressure to fulfil the daily requirement of the people. This alone accounts for 19% usage of the available resource. Expanding cities, luxurious life style and neglect of water bodies are adding to the non-availability of water for domestic use.

2. Agriculture Use: This accounts for the majority of water consumption in our country since agriculture is the backbone of our economy. Agriculture is the largest consumer of freshwater resources. Due to an ever-increasing population the need for agricultural products is also on the increase due to an increase in irrigational needs. This will even further the water resource and add more pressure to the existing problems of water scarcity.

3. Industrial Use: The next primary area where water is an indispensable commodity is industry. It has varied uses such as raw material coolant, a solvent, for transportation purpose and a major source of energy. Industrialised countries face a very grave threat as more than half of the available water resource is used for industries, leaving very minimum left for domestic purpose.

4. Source of Energy: The best use made out of water resource is generation

of Hydropower. It is process where energy from the gushing water is converted into electricity and used for domestic and industrial purposes. India is one of the leading countries in generating hydropower among the global countries. It is a major form of renewable source of energy and also free from polluting factors.

5. Other uses: Apart from the above discussed uses water is also used for navigation and recreation purposes. Navigation of water courses is used for transport purposes. India has well connected rivers and navigation across rivers is an important form of transport for goods and people. Also since India is a peninsula and surrounded by waters, sea transport is an important mode to connect the neighboring countries to transport goods and people. Water is also used for recreational purposes like swimming, water sports and boating.

Exploitation of Water Resources: In today's global context, one of most important crises is the issue of water shortage. The teeming world population requires plenty of water resource and the resource is getting depleted at a very faster rate. Water is a renewable resource, but several factors such as population explosion, deforestation, soil erosion and water pollution all contribute to the over-exploitation of the resource. Scarcity of water leads to drought conditions. Nearly 25% of India's population is living in drought like condition, which is approximately 330 million people, with the situation being worst in Western and Southern India.

People rely heavily on the ground water. The withdrawal of the ground water is at a very faster rate when compared to the rate at which it is replenished. This lowers the water table, leading to sea water to intrude into its space. Thus, the salinity of water increases, which makes the water unusable for agriculture and domestic purposes. Water resources are also polluted easily as harmful chemical and industrial wastes are released into water bodies. This damages the entire ecosystem of the water bodies and renders it unusable for human consumption as well as for the aquatic organisms that thrive in it. Untreated sewage is also let out into water bodies, which is a major source of polluting the water in major parts of the country.

Consequences of Over Utilization of Water Resources:

Water being a primary and essential resource becomes a great cause of concern when scarcity arises. Over utilization of this resource will lead to water scarcity, which is the first major consequence of over utilization of

water. At present we are witnessing several disputes among states over the issue of sharing the water resources. For example the Cauvery water dispute between Tamil Nadu and Karnataka, the Sutluj – Yamuna canal dispute, between the states of Punjab, Haryana, UP, Rajasthan and Delhi are intra state dispute and remains unresolved even after judicial interventions. Analysis by the World Health Organisation (WHO) suggests that by 2050, nearly 52% of the entire global population will be facing the problem of water scarcity.

Rise in global temperatures, has an adverse effect on the hydrological pattern. This in turn impacts the level of surface water and ground water. The lower levels of water table and the increase in the salinity of water will again impact the pattern of vegetation leading to severe consequences. Thus, it ends up in a vicious circle. Rising temperatures also increase the rate at which precipitation takes place once again impacting the water levels.

Floods and droughts, the two extreme forms of natural hazards that occur all over the globe is also a consequence of over utilization of resources. As the water levels decrease, there is an increased risk of water bodies getting dried up, destruction of vegetation and the soil losing its fertility. When rains occur, these water bodies will no longer be able to hold the water and the tree cover will not absorb the excess of water, thus causing floods. Hence, floods and droughts will become a common phenomenon, leading to large scale destruction of life, property and valuable resources.

Construction of Dams is one very important solution to the pressing problem of water scarcity. Dams are built across stream, river or an estuary to conserve and preserve excess water. This water can be used for human consumption, agricultural and industrial use. These also provide other major benefits such as generation of hydroelectric, flood control, irrigation to arid regions, soil protection and also ensures availability of water all through the year. Major river valley projects also provide inland water navigation as well as employment opportunities as they have tremendous potential for economic upliftment. Fish hatcheries, nurseries are some forms of economic activities that take place here. Yet, there are certain problems also that are faced due to construction of such projects. Large areas are utilized for this purpose, which leads to loss of the local ecosystem and also the displacement of the local and tribal population. Increased salinity in the water content leads to destruction of the aquatic eco system. Valuable nutrients are lost due to siltation and

sedimentation of reservoirs. Stagnation and water logging may lead to vector-borne diseases.

Hence, water being an indispensable resource, must be used with great caution and pollution of water bodies must be prevented at all levels. Governmental action, with the support of NGOs must create the necessary awareness for the same. Each individual should use the valuable resource with utmost caution and be responsible for their actions. Planting of more trees and stopping the contamination of water bodies will go a long way in sustaining this most valuable renewable resource.

1.13 Land Resources

Amongst all the valuable resources, land is one such finite resource. We depend on land for all our basic amenities. Land resource refers to all landforms such as, hills, mountains, valleys, plains, river basins and wetlands. Each land form has variety of resources which are of great use to the community of people depended on it. With the progress in science and technology land resources available in one part of the country can also be made available to the rest of the nation. Land is the most important prerequisite for the social and economic activities of human kind. Land is required for settlement, agriculture, industrial purpose and for building any form of infrastructure.

The most important composition of land resource is soil. Soil is a thin covering on the land surface which consists of organic material, living organisms, air and water. This is the major requirement for all other resources directly or indirectly. Soil is a renewable source, however once degraded, regeneration of soil takes place at a very slow pace. In this aspect soil becomes a non-renewable resource. The process of soil losing its fertility and becoming unproductive is termed as land degradation. The increase in population adds to the pressure on soil to produce more for sustaining the population. Over use of fertilizers also tend to deprive soil of its natural fertility and in the long run make it completely barren. Not only food, demand for fibre, wood and other agricultural products lead to more pressure on the soil. Thus, we tend to overexploit the limited land resource which further degrades the land. In the presentday context over 56% of the total geographical area of India is affected by degradation.

Apart from this cause, other natural causes such as land slide, volcanoes, earthquakes, floods, droughts, soil erosion and desertification

all lead to land degradation. Human induced factors also contribute their share in this process. Activities such as deforestation, mining, irrigation, hydroelectric projects such as building of dams, reservoirs are some factors leading to degradation of land resources.

The process of loss or removal of the top layer or the superficial layer of the soil due to various factors is termed as soil erosion. This can occur either naturally or through man-made activities. Natural occurrence or geological erosion is the gradual removal of the top layer of the soil through the natural process. The soil erosion caused through man-made activities is very sudden and frequent in occurrence. In comparison the rate of geological erosion is much slower than erosion through man made activities. Water and wind are the two agents which cause natural erosion of the soil. Heavy rains, rapid and forceful flow of water and flooding of river banks are the natural occurrences of water causing soil erosion. Heavy winds and natural calamities like cyclones, tornadoes are ways in which winds can cause soil erosion. The manmade activities or the biotic agents are the major factors causing soil erosion. Over grazing, mining and deforestation are the major biotic agents which result in soil erosion. Overgrazing of grasslands amounts to nearly 35% of soil erosion, whereas 30% of erosion occurs due to deforestation. The rest of the factors like landslides, constructions of roads, dams, buildings and river valley projects tend to erode the soil and make it unproductive.

Severe soil erosion will lead to the worst form of exploitation of land resource known as desertification. The process by which the productive potential of arid or semiarid land falls by ten percent of more is known as Desertification. There are various stages of desertification. When the productivity drops from 10 to 25% it is known as Moderate Desertification. If the productivity of the cropland falls from 25% to 50% it is Severe Desertification and more than 50% is classified as very severe desertification. The characteristic features of cropland turning into a desert is devegetation, depletion of ground water and salinization. In India, out of the total geographical area of 328.72 million hectares, 96.4 million hectares i.e., 32% is under desertification. Twenty-six Indian states have reported increase in area under desertification in the past ten years. Major reasons for desertification are unsustainable agricultural practices, population explosion, surface mining, quarrying, famine, flood and global warming.

Conservation of Land Resource: The best way to protect the valuable, finite land resource is to apply conservation techniques. Some of the forms of conservation are:

Organic Farming: The process of increasing the organic input of the soil is called as organic farming. The use of bi-fertilizers is the most important aspect of this farming. The practice of conservational tillage will also increase the fertility of the soil. In this method, residues of previous crops are mixed into the soil by ploughing. It improves soil permeability and increases the percentage of organic matter in the soil which will in turn improve soil moisture and nutrients in the soil. Mulching can also be practiced, where soil is covered with crop residues and other forms of plant litters.

Crop rotation and Contour Ploughing: The process of growing different crops in succession on the same land is termed as crop rotation. This will help to prevent the loss of fertility of the soil. In areas where rain fall is very low, the method of contour ploughing i.e., placing furrow to store water will reduce the rate of water run off and soil erosion.

Other techniques like Strip cropping, Terrace farming (in hilly terrain), agroforestry (the practice of planting crops between trees or shrubs) and wind breaks (trees planted on boundaries of cultivated land, to prevent winds from causing soil erosion) can be practiced wherever applicable to reduce the soil from being eroded and help in conserving the resource.

1.14 Mineral Resource

Mineral is defined as a natural substance of organic or inorganic origin with definite chemical or physical properties. Due to the geological structure, India possesses a rich variety of mineral resources. Most of these are associated with metamorphic and igneous rocks found in peninsular India. They are non-renewable natural resources. A nation's economy depends on minerals as they are basis for industrial development. Minerals are classified into two types – Metallic and Nonmetallic. Metals are extracted from metallic minerals and can also be termed as inorganic minerals. For example, Iron ore, copper, gold etc. These can also be further classified as Ferrous and Non- ferrous minerals. This is based on the iron content in the mineral. Minerals with iron content are termed as Ferrous and the rest are classified as Non-ferrous inorganic minerals. On the other hand, Non-metallic minerals can be either organic in origin such as fossil

fuels (mineral fuels) since they are formed from the buried plant or animal life or inorganic non-metallic minerals such as mica, limestone, graphite etc., Coal and petroleum are the major forms of fossil fuels.

Characteristic features of minerals:

Minerals are unevenly distributed over space. Since several geological factors play a major role in the formation of minerals, they are found in varied quantities in different geographical locations. In India, mineral deposits can be found in peninsular India, whereas the rich alluvial plains of northern India lack mineral deposits. Minerals are non-renewable resources and hence exhaustible in nature. This is because of the fact that the process of formation of minerals is very long and takes millions of years to happen. It is completely a natural process without any human intervention. Thus, once the resource is utilized it cannot be replenished. The only way to protect this resource is to conserve it. Further, the amount of this resource availability is also finite which makes it even more vulnerable to exploitation.

Uses of Mineral Resources:

Minerals form the basis of all industrial processes. The building of industries, machineries, infrastructure all require minerals. All forms of industries are dependent on minerals. Thus, they are basis of economic development of the country. Since the beginning of use of energy resources, human kind has dependent on conventional energy resources for all purposes. The use of coal and petroleum for both domestic and industrial purpose is indispensable for mankind. From making of essential products for daily use to production of arms and ammunition for defense purposes, minerals are needed for every form of manufacturing. Every commercial product that is manufactured needs some form of mineral as the raw material. This has led to severe strain on this resource and now is facing depletion.

Exploitation of Mineral Resource:

The major form of mineral exploitation is due to the mining industry. Mining is the process where minerals are taken from their deposits. Minerals are mined using process such as open cast mining, underground mining and placer mining. In every process of mining, lot of other minerals get impacted. Following unscientific methods of mining leads to further problems impacting the environment and ecosystem

surrounding the mines. These forms of mining are unsafe leading to several miners being trapped below the earth surface and losing their lives.

The growing population leads to increase in demand of all commodities and hence the demand for minerals is ever on the increase. Unstainable practices of extracting the minerals and exploiting the land for mining makes it very harmful for the environment. The following are the impact of careless exploitation of minerals:

The harmful affluentsthat are released from the extraction of minerals pollute the atmosphere. For example, Sulphur di-oxide SO2, Nitrogen di-oxide NO2 and Carbon monoxide CO are released into the atmosphere in the process of extraction. Hydrocarbons, metallic dust are also harmful by products which can cause health hazards.

Soil erosion is an important consequence of mining. The surface layer of the soil is completely lost and the region becomes arid because the entire ground water is depleted for the mining process. Felling of trees is also done in a very large manner to clear areas where mining is done. This causes severe damage to the environment and disrupts the ecological balance. Mining is a very important cause for ***land degradation.***

Water pollution is also a resultant consequence due to letting of waste dumps into nearby water sources. The surface water also gets contaminated due to the increase in acidic content due to the mineral waste being dumped hazardously. Usage of explosives is carried on in unscientific methods of mining. This leads to noise pollution and other health hazards.

The only way to protect this valuable resource is to conserve it and use ecofriendly methods of mining. Greed for more and following of unethical practices will only lead to extinction of this resource. Strict observance of mining laws is necessary to prevent illegal operations.

1.15 Conclusion

The resources available in our environment are very essential for life to sustain on planet earth. The interaction of every species with the biotic and abiotic components of the environment constitutes the ecology of a region. The environment performs various functions without human intervention. Over exploitation of the resources in the environment and man-made activities of polluting the environment will lead to degradation

of the environment and loss of several species on earth. The development of technology has enabled better understanding of our surroundings and gives us accurate data to base our study on. This enables us to plan for sustainable development and adapt new methods to conserve our resources and enhances the scope of this area of study and research. Environmental Studies is extremely important as it gives us an understanding the need to preserve these and the challenges, we face in doing so. It also encourages active participation at all levels in the society to contribute our part in protecting our environment. Life exists on this planet due to the Natural Resources. Preservation of each of this natural resource is essential as these are all interdependent on each other and impact on any one of the resources will start a chain of reactions which will deplete the other resources as well. Governmental legislation, public awareness and individual responsibility have to be exercised to protect and conserve these resources so that life can continue on this planet.

1.16 Let us sum up

The totality of all the resources surrounding us is termed as our environment. There are several factors which impact the environment. These factors are dependent on each other and impact on any one factor will set in motion a chain of reactions. The major function is to sustain life on earth. Environmental Studies is an important branch of science which deals with various aspects of the environment. It is multi-disciplinary as it relies on many other disciplinary for better understanding and comprehensive research. Natural resources have been formed without human intervention and are very necessary for the growth and progress of civilization. These resources can be classified on the basis of their renewability, their origin and the state in which they are available at present. They play a major role in the economic growth of a nation. It is important to use these resources in a sustainable manner so that they do not become extinct.

1.17 Self Assessment

1. Define Environment and state its major factors.
2. Define Ecology and highlight its significance.
3. State the major functions of the environment.
4. Define the Environmental Study and explain its scope.
5. Highlight the multidisciplinary aspect of environmental study.

6. State the importance of Environmental Studies.
7. Define Natural Resources and state their types.
8. State some measures to conserve forest resources.
9. Mention methods to protect water resources.
10. State the significance of mineral resources.

UNIT - II

Lesson 2.1 - Use of Resources and Environment

Structure

2.1 Learning Objectives

The main objectives of this unit are

1. To facilitate the understanding of the usage of Environment by the human intervention historically
2. To reiterate the relationship of human and their co-existence with the natural world
3. To trace the impact of state and economic policy towards environment
4. To expand the contextual insights on the deforestation in India
5. To accelerate the coherency of colonial policy and its impacts on deforestation in India.

Keywords:

Hunting, Food gathering, Survival Strategy, Environmental adaptability, Domestication, Civilization, Deforestation, Colonial Deforestation, Forest Act, Forestry.

2.2 Introduction

Frernard Braudel said, 'Societies live within nature, dominated by the inexorable logic of the relationship between biology, tradition and Mind'. Biologically human are Homo Spaiens an upright walking species first evolved in Africa about 315,000 years ago. The theory of human evolution acquired inherent characters as held by Lamarck, Darwin and others postulated that environmental influences on Humans. It is generally accepted that the role of environment as sieve favoring the suitable and rejecting the less suitable. Humans lived with nature, engaged with nature and made of nature logically. Nature provided shelter and resources for survival. Forest was the dwelling places for pre-historic people. Pre historic community survived with naturally available sources like fruits, vegetables, roots and prey with small and big. In the evolution of human kingdom, nature and environment played a central role.

2.3: Food Gathering / Hunter-gatherer

Hunter-gatherer culture was the way of life for early humans until around 11,000 to 12,000 years ago. Food gatherers often referred as hunter gatherers were early humans relied on foraging for food rather than engaging in settled life followed by agriculture and animal husbandry. Forging food and Hunting lifestyle existed during the Paleolithic era began around 2.5 million years ago and ended around 10,000 years ago with the advent of agriculture. The key method of acquiring food relies on hunting and fishing animals and forging for wild vegetation and other nutrients like honey. Earlier to the emergence of hunter gatherers state, people relied on the practice of scavenging animal remains that predators left.

Hunting & Food gathering in Natural Environment

a). Nomadic for Mobility and Survival strategy

Hunter gatherers and food collectors applied mobility and movement as survival scheme. Hunter gatherers were required access to larger areas of land rich in vegetation and plains to hunt. They were generally nomadic

moving from one location to another in search of seasonal food sources. This mobility synchronized with the environmental system was essential for their survival. Living environment of Hunter gatherers necessitated them to follow the migrants of animal herds and with the availability of seasonal plant resources.

b). Diverse Diet

Hunters' community and food collectors had multiple diet verities depends on local Environment. Food sources included animals, fish, shellfish, fruits, vegetables, roots, mushrooms, nuts and seeds. The Hunting and gathering of food varieties differed by region and season.

c). Environmental adaptability

Hunter- gatherers communities had to adopt changing environmental conditions and seasons. It required a better understanding of their ecology and environment. Hunter gatherers pursued simplicity, adaptability and harmony with natural environment.

The Hunter gatherers life style was abandoned and lead to a settlement pattern of life style particularly to riverside was formed and tipped as ancient civilization. But some of the African tribes, still hold features of food gatherers, the Hadza people of Tanzania are a good examples for Food gatherer attributes.

Hunter Gatherers of Andaman and Nicobar Islands

The Andaman Islands are home to 'Negrito Tribe"- the Great Andamanese, Onge, Jarwa, Sentinelese, Shompens and Nicobarese. They are believed to have reached this island around 60,000 years ago. Among these tribes except Nicobarese, other tribes are relatively isolated and nomadic- hunter and food gatherers. They do hunting for their survival. They mainly hunt wild pigs, lizards and thrive with wild honey, fruits and vegetables. Their life remained unchanged for thousand years. Post Tsunami period and development activities in the island largely impacted their life and their culture started to change. Their survival depends on as long as their land and resources are secure and not troubled.

2.4 Pastoralism

Pastoralism is a type of semi-nomadic subsistence practice in which people primarily rely on the herding of domesticated animals such

as cattle, sheep, goats and camels for their livelihoods. Their lifestyle is typically associated with arid and semi - arid zones. These regions were inhospitable and not suitable for traditional agriculture due to limited water resources and extreme weather conditions.

Pastoral mode of life is dependent primarily upon herding of animals and involving regular movements to new pasture lands. The needs of their animals are important motivating factors in the life of traditional Pastoral nomads. Their periodic movements are occasioned by the need to find new pasture land when grazing is no longer possible in the area currently being visited. The regions where pastoral nomadism is established are moreover those which are agriculturally unproductive. They may be along the periphery of the cultivated areas or unarable pockets of land within grain producing regions may provide acceptable grazing for flocks and herds.

Ecology of Pastoral Societies: (Ecological Adaption)

Pastoral mode of life representing a dynamic ecological adaption, is subject to change as the eco-system itself changes. Cultivation on a small scale might be done by a society which remains wholly nomadic, the sown fields or date orchards being located at the place of summer pasture. The nature of a pastoral nomadic settlement and the associate importance of agriculture can best be visualized as a mobile point along a continuum with 'fully sedentary' marking one end and "wholly impermanent" the other. The importance of the physical and biotic environment in influencing the spatial and social organizations of pastoral societies is very important in understanding life Pastoral life. Cultural ecologists interpret pastoralist's spatial and social behavior as adoptive responses to specific features of the natural environment such as climate, seasonality, vegetation and water sources. The spatial behavior of nomadic pastoralist primarily was on the sophisticated knowledge of environmental characteristics and processes. They choose the general area to optimize food and water availability to livestock and minimize the discomforts of occupants. The actual site of settlement is usually selected for some specific attraction such as the presence of shade trees. The conditions used to identify prime location include texture, drainage and color of soil, gradient and length of hill slopes and nature of the vegetation.

Pastoralism in India's Environment

The Vedic Literature throws ample evidence about nomadic pastoral societies in the Ancient History of India. The Rig Veda represents the very earliest of Sanskrit works mentions that the *'Aryans first entered the Punjab with herds of cattle and wagon from the west'*. It is a society which has shifted some distance towards the 'sedentary' end of the 'mobility continuum'. Archaeological evidences pertaining to the beginning of the herding of domesticated animals appeared in Southern Deccan on the hilly flanks and plateaus of Karnataka, Telangana and Rayalaseema and the alluvial zones of the Godavari Krishna – Pennar River systems and their tributaries. Traces of Pastoralism Communities belong to Chalcolithic, Iron Age has been found in Baluch, Brahuri, Himalayan Gaddi, Bakkarwal of Kashmir, Ganganagar of Rajastan, Rabari in Kutch region of Gujarat. Scholar like D.V. Rangnekar was read widely to reconstruct the history of Pastoral Communities of Ancient India. His book titled, '*Traditional Livestock Production Systems among Pastoralist; their traditional perception of the production system and attitude to change*' describes economic and ecological situations of different pastoral communities. These studies examine the various aspects of ecological and economic adaptations of pastoral nomads.

2.5 Settled Cultivation and Environment

Around 12,000 years ago, humans started to involve in cultivation. Proceeding to the phase of settled cultivation, human lived as hunter gatherers, nomads and Pastoralist. They had their food by hunting animals and gathering vegetables, fish, honey and different fruits from their environment. They gradually moved into shifting agriculture. Shifting agriculture means cultivators would farm only for a few years before shifting to the next place. This pattern of life style changed into Settled cultivation likely first to begun in Mesopotamia around 12,000 years ago. Settled cultivation altered their environment for their need and necessity. The alternation in environment includes burning down inhospitable forests to clear the way for nutritious new plants to grow. Through the food gatherers cultivators collected the seeds particularly of tasty in nature. The early crops cultivated by humans are (i) Wheat (ii) Barley (iii) Peas (iv) Lentils (v) Bitter vetch (vi) Chick Peas. This settled cultivation practice was perhaps the most important stage event in human evolution. Settled agriculture provided early humans with a sustainable and long

lasting food source. Cultivation practice was more efficient than hunting and food gathering. Settled agriculture also supported the people to settle in a single location which leads to the birth of ancient civilizations. This cultivation revolution was perhaps the most stage event in the human evolution. Settled agriculture provided early human with a sustainable and long lasting food source. Cultivation practice was more efficient than hunting and food gathering. Settled agriculture also assisted people settled to a single location.

2.6 Industrial Revolution

The Industrial revolution reworked the earth's landscape altering the foundation of society based on agriculture and placing it on the road to modern economic developments. Humankind's relationship with the natural world was profoundly affected. The industrial revolution was a part of tremendous ecological restructuring and significant impacts in the earth's environmental history. Industrialization involved significant shift in humankinds relationship with nature on ecological perspective may help us discover the roots of that change. In view of the anthropologist John Bennett 'nature was ever more defined in terms of human wants and needs'. Although the transition was a long time in the making it gained its greatest momentum during the industrial revolution and further states the restructuring of humankinds relationship with nature so central to industrialization was not without its ecological consequences. The ecological consequence and uneven development in society have been a direct result of soil degradation and erosion, deforestation, drought and desertification and mineral depletion. The rapid exploitation and overdependence on fossil fuels and mineral resources added more damage to the ecology and people environment through the problem of pollution. Anthropogenic epoch begins with coming of the industrial revolution has opened up a Pandora's Box of unintended environmental change.

2.7 Deforestation and Environment

The causes of deforestation according to ancient writers included agricultural clearance, pastoralism, commercial tree cutting, warfare and human uses. When Plato described the deforested state of Athens, he gives evidences from observation 'in buildings he had seen large beams from trees cut on hillsides only shrubs grew in his own days. In his time Strabo complains the forest of Pisa was being consumed to construct buildings

in Rome and villas of Persian magnificence in the countryside. To get suitable timber for shipbuilding that good forests were generally limited to mountain and that sources of valuable wood has been exhausted. To understand the meaning of deforestation for the ancients, we need to place it in the context of some of the meaning found in the forest itself. In antiquity a dominant idea was that forests were inhabited by gods. Thus sacred groves were revered as temple and this reverence became a motive for forest preservations.

Factors of Deforestation

Ancients evaluated the process of deforestation with its causes and effects; they did so predominantly in connection with human interventions and activities. First their conceptions to the causes of deforestation will be considered beginning with clearing for agriculture. This was viewed as laudable progress, since the destruction of a forest could produce a fine wheat field. Agricultural writers commend several ways of reducing a wooded area to an arable state. Pastoralism was also seen as a cause of deforestation. Herds of goats, sheep cattle and swine grazed through forests. Also herdsmen cut branches to give animal leaves and started fires to improve grazing. Another course of deforestation described by classical authors is commercial use of wood. There is much information on the timber trade and on the activities associated with it. Writers tell how timber was moved; logs were hauled out by draft animals, often floated down rivers to ports, and then shifted to population centers. Governments saw it in their interest to encourage shipbuilding and the timber trade. State also facilitated private exploitation of forest through lease or state. Classical authors viewed as forests as a natural resources. They mention great varieties of uses for wood and other forest products. Forest woods as fuel and its transformation into charcoal for industries like ceramics and metallurgy. Mining was also seen as a direct cause of deforestation. Another cause of deforestation was warfare which took its toll of forests. Soldiers were detailed to cut wood. Forests were deliberately destroyed. They set forest fires to harry the enemy troops. All these causes involves human agency. Although some natural causes were also assigned such as insects, disease and spontaneous wildfire.

2.8 Neolithic Culture and Environment

Neolithic culture is a revolutionary phase of human evolution. Neolithic

revolution is also called as Agricultural revolution. It is believed to have begun about 12,000 years ago. In Neolithic phase of life foreigners became farmer and hunter gatherers lifestyle transformed into settled lifestyle. Neolithic population lived in a world of dynamic climate change. During the course of Neolithic culture complex developments in social and settlement organization have taken place. Historical ecology is a discipline provides a conceptual approach to understand the ways how the human societies and the environment affect each other.

Human – Environmental Interactions

Humans and environments interact in a dynamic and reciprocal fashion. Everything people do affects the environment whilst everything the environment does affects people and this is a continuous process of co-adaptation or mutual change and adjustments. Human- environmental interactions took place at varying short and long term scales. An earthquake would be rather abrupt, whilst deforestation, agriculture and erosion make take place over several decades. In each situation people work within their total environment both the cultural and natural parts and any changes they make require altering their cultural traditions or their physical environment.

Neolithic Culture in India

The subcontinent of India lying in the wet and dry tropics is a region potentially rich in natural resources. The first find of a Neolithic in India was made in 1860 by H.P. Measurier, who drew attention to his discovery of ground and polished stone implements in the valley of the East Tons River in the United Provinces (Modern Utter Pradesh). By definition the Neolithic pertains to the Stone Age and the primary trait that sets it apart from the other cultures of that age is deliberate food production as opposed to mere food gathering as the means of subsistence. The secondary traits often associated with the Neolithic culture are manufacture of pottery and smoothed stone tools. Neolithic pattern in India showing four provinces- A, B, C and D. Province A is restricted to Western Madhya Pradesh and western India, co-extensive with the Deccan Trap region. The areas covers under this province are Nagda and Ahar of the Chambal valley, Maheswar Mehgam and Tripuri of the Narmada valley Bahal, Tekwada and Prakash of Tapti valley, Nasik Jorwe and Nevasa of Godavari valley, Maski and Nagarjunakonda of the Krishna Valley, Brahmagiri and Sanganakallu of the Tungabhadra valley. Province B is centered in the Karnataka in south

India away from the Deccan trap region, it include the Karnataka and Salem region. Province C is restricted to east India covers Assam, Bengal, Bihar and Orissa region. Province D had a distinct culture to be traced to Baluchistan it covers largely the Kashmir valley.

Cultivation & Domestication of Neolithic India

The cultivation of wheat and barley cultivated around 7000 BC at Mehrgarh. These two crops reached Deccan after 2000 BC and barely appeared in Central and Eastern India around the middle of the third millennium. The domestication of sheep and goats has appeared to 6000 BC at Adamgarh. Among the domesticated the Zebu oxen are peculiar to India and this breed of oxen was the result of local environmental endeavor.

Deforestation in Neolithic India

Rivers provided a perennial source of water to the earliest settlers of Neolithic culture. There were other geographical considerations that impacted on Neolithic habitation. The deposit of alluvial soil made Neolithic farming easier. The rivers might also have solved to same extent the problem of food. Due of heavy rainfall in the area there was luxuriant growth of vegetation, which might have been cleared by the rivers without much labour. The animals that roamed in to forests might have been used as building materials. The Neolithic inhabitants lived in houses made of reed and mud. Mud was plastered over the bamboo screen from outside and inside. Deforestation might have happen in Neolithic community because of pastoralism, and large scale of wood for the habitation purpose. Added to that the forest area covers alluvial soil was destroyed for the cultivation purposes.

2.9 Civilization and Deforestation

Ancient civilization has deforested and eroded landscapes as their settings demanded do not seem to be an accident. There was a synchronicity, the contemporaneous ruin of ancient societies and ancient environment has been inescapable. Forest provided the major material for construction and almost the only fuel source of the civilization. As forest retracted with land clearance, wood decreased in availability. In the more arid regions forest that formerly moderated the climate and equalized the water supply was stripped away permitting the desert to advance. In the decline of ancient civilization a contemporaneous deterioration of environment and peoples

of which the causes were man made not natural. Forces of environmental deterioration and their interaction with one another in producing direct and secondary impacts felt on the economy (including Agricultural production) health, population and social structure.

The Demand for Forest Products

The single most important use of wood and its carbonized product, charcoal was as fuel. Ninety percent of all woods used were consumed for the fuel purpose. Woodcutters were kept busy supplying fuel wood and haulers were well paid for transporting it into cities on mules and donkeys. Such wood was reduced to charcoal before being used as fuel. Charcoal produced a higher more even heat with less smoke and flame and thus found uses in ceramics, pottery, bricks and tiles; melted the melt for statues, utensils and weapons.

In addition to fuel, forests were used for building materials. Cities required timber to build houses and public buildings such as temples and theaters. Even after most large buildings began to be constructed of stone or brick, beams and rafters were of timber and scaffolding and ramps were needed. Doors and their frames and hinges were often of wood and roofs were covered with shingles.

Ancient also depended upon the woodlands for war materials. Forest supplied wood not only for ship but also for chariots, battering arms and siege engines and stock for a host of weapons. Ramparts of fortifications often consisted of tree trunks set closer together. Armies took their toll upon the forest. Detachments of soldiers cut wood for fortifications and fuel. Another major cause of forest removal was the clearance of land for farming. Trees were uprooted and removed or cut down burned in place and others plowed and the ashes plowed and used as valued fertilizer. Even more destructive than agricultural clearing were the wide ranging herds of grazing and browsing animals. All the herd animals were encouraged to graze in the season advanced. But the goat was identified as the true destroyer of forests. Forest cleaning was all practiced by the shepherds as well as by their flocks. The object was to improve grazing by replacing forest with grass. Added to this wildfires usually ranged unchecked unless they threatened a settlement. Wildfires kill animals and destroys vegetation tend to be catastrophic, almost completely denuding the slopes.

The impacts of Deforestation and decline of the Indus Civilization

The common results of deforestation are erosion of the hillside flooding as the gathering water no longer retarded and absorbed disruption of the water supply and siltation of lowlands and coastlands. Excessive exploitation of forest coverage leads to climate change of the Indus region. This leads to reduction of rail fall around 1800 BCE. On the other reasons, the shift of the courses Yamuna and Sutlej to the east and west would have considerably reduced the availability of both surface and sub-surface water in Ghaggar valley. This would affect both natural vegetation and agriculture.

2.10 Deforestation During Medieval India

India has witnessed a paradigm shift in the political situation after the coming of Islamic rule. The socio- cultural and economic shifts occurred in rapid manner leads to both continuity and discontinuity of ancient practices. The Persian influence and coming of new religious order into the rule brought changes in all perspectives. The new rule under Delhi Sultanate introduced and initiated new economic policy. It has direct effects on the forest and natural environment of the region very particularly in the Gangetic plains. Cleaning of forest or otherwise the deforestation was done in high scale by the Delhi Sultans to encourage and to increase the proximity of cultivable lands. The Delhi Sultans cleared the forests in the Ganga- Yamuna doab and gave the lands to peasants in order to encourage agriculture. They also established new fortress and garrison town in the hinterlands to protect trade routes and to promote regional trade. They also cleared forest in order to safeguard frontiers and to facilitate the quick movement of their army.

Natural world (Forest) in Babur's *Babarnama and Jahangir's Tuzuk-i-Jahangiri*

Although scattered reference about the natural resources in several medieval texts, it enables us to construct the history of flora and fauna of the time. Generally wild animals are mentioned, particularly in case of hunting expedition. There are two sources from detailed descriptions on natural resources is available: the *Baburnama and the Tuzuk-i-Jahangiri.* Both are memoirs. Babur and Jahangir appears to be personally interested in the flora and fauna and their memoirs are replete with information on natural resources. Babur in *Babarnama* gives detailed descriptions of the

flora and fauna of Medieval India. Different varieties of exotic animals, bird and trees were documented. Till the end of his days Babur retained his interest in nature and animals. Babur seems keenly interested in the fauna and flora of India. He provides minute details on the subject and appreciated it with great understanding. Babur was less enthusiastic when it comes to Forests. These natural historical studies were later extensively illustrated by artist in Akbar's atelier and comprise over 120 illustrated folios. Abul Fazal mentions that large number of men took part in elephant and tiger hunts.

Forest Policy during Mughal Reign

The Mughal period (1526-1858) was characterized by continuous destructions of forest for timber and clearance for cultivation. Mughal forest policy was built on two principles. One it was exclusively used for hunting purposes. Two forever properties extracted and meant to yield revenues. There were no restrictions on cutting of trees except 'Royal Trees' which enjoyed patronage from being cut except upon a fee.

Deforestation

The Environmental implications of the changes on the agrarian frontier in the medieval era are a ground clearance phase for the maximum extraction which was occurred in Colonial administration. Successive rulers tried to extend settled, cultivated arable into fresh lands to increase revenue and to strengthen their kingdom. In the 17th century, the Mughal Empire bore down heavily on the nomadic tribe in the hilly and deltaic regions of Sind. A mix of military might, religious proselytization and revenue remission were employed to try and induce sedentary settlement among the nomads. The tug of war between the agrarian hinterlands and the drier or the forested hinterlands was not specific to colonial ruler alone. In the 19th century, Ranjit Singh's Sikh state tried to settle the nomadic Gujjars and Bhattis in the Punjab. Even though states did not normally promote direct management of uncultivated lands, disincentives and incentives did retard or speed up the process of agrarian extension. Thus the medieval reign on both imperial and regional level the state has subjected the forest and forest resources for revenue generation and as temporal space to expand the state legitimacy over the peoples. The state encouraged the local officials and *Mansab* to extract the forest resources to the maximum to reciprocally to increase the tax revenues. The agricultural expansion on the cost of deforestation started from medieval history of India.

2.11 Colonialism and Forestry in India

The contribution of revenue needs, expansion of commercial crops and development of the mining industry accentuated the powerful impacts that building railways had on India Forestry in the 19th century. Wood from the forest in the forms of sleepers for railways tracks and fuel for steam engines provided vital inputs into this system. Forest was integrated into the market economy by forest administration.

Ecological Imperialism

Deforestation in India was axiomatic of the principle economic and ecological changes during colonial times. The history of ecological imperialism would be manifest in the pattern of tree species exploited, planted and regulated by law and Silviculture science. There was a transformation of virgin forests into plantations of rubber, tea and spices in the northeastern and southwestern parts of India. Initially the exploitation of forest resources assembled from the Himalayan region, *sal and deodar* were exploited for railway sleepers and construction in the infrastructure development phase. Later Chir Pine was mercilessly tapped for chemical industries in manufacturing phase. In addressing the demand for more vivid knowledge of India forest resources, British policy makers evolved an elaborative administrative structure, a stringent legal code and body of scientific practice. Forest policy also rested on ideological formulations arising from culturally delineated past of colonists and indigenous societies.

Nature of Colonial Deforestation in India

Deforestation in Colonial phase not only identified in terms of the declining vegetational cover but also as extracting more wood than the regenerative capacity of forest. Unsustainable extraction of forest resources does not directly lead to denudation but it apparently lead to slow degradation of Environment. The British continued the pre-colonial policy towards forests, continuing the role of the state only to the collection of certain forest dues along the foothills. As forest gained importance by the late 1840s due to the increased demand for timber and firewood the government wants to monopoly the entire forest resources. In 1858 all forest were placed under the commissioner of forest. The forest act of 1865 and 1878 facilitated the extension of control over these forests. By 1879, almost resourceful forest coverage was declared as reserved forest.

In these reserved forest the rights of local people were redefined, they were granted only limited rights that were recorded and specified in the forest settlement. In 1893 all un-assessed land outside the reserved forest was constituted as the District protected Forest to be managed and regulated by the deputy commissioner.

The Growth of Wood Extraction and Timber Trade

Wood extraction has multiplied over time from the early colonial period till 1947. In the first phase, timber extraction for trade had not acquired great significance and the forest exploitations were merely being exploited. In the second phase beginning with the establishment of the forest department in 1864 and passing of the Forest act in 1865, state control over forests was strengthened and most of the forests were made available for exploitation. This led to the rapid growth of extraction of timber. The third phase began with the world wars when the nature of the demands made on forest was changing.

Evolution of Forest policy in Colonial India

The growth of the forest policies in India was slow. According to Stebbing, the writer of the three volumes of the book The Forests of India (London, 1922-1927) the slow progress was due to the confinement of "scientific knowledge amongst European Officials … almost entirely to the member of the medical profession." Further "forest were considered as an obstruction to agriculture rather than otherwise and consequently a bar to the property of the Empire". There were at least three distinct phases of colonial forest policies in India, one covering the period from 1796 – 1850, the second phase from 1850s to the 1880s and 1894 to1947.

Four Broad features of Colonial Forest Policy in India

1. The material interests of the state, especially the wood requirements for shipbuilding, railways, government departments and industries were the main driving force for the forest policies of the colonial state.
2. In the colonial period, conservation of forests was often linked with the change of rainfall and climate; it has been increasingly connected in post-colonial era with the wider issue of environment and sustainability.
3. In the forest policy formulation process, the colonial bureaucracy

was often in conflict with the revenue and agricultural departments.

4. Colonial forest policies, imposition of regulation for the reserved and protected forests of various kinds and limitation of the rights and privileges of people in other forests naturally led to sporadic conflicts between the state and the communities.

Deforestation and Birth of Indian Railways

The enormous demand thrust by the railways on forests was leading to deforestation. Elizabeth Whitcombe writes: 'Perhaps the most disturbing consequences of the railways most disturbing because the widespread use of local timber as fuel for the locomotives'. The timber and firewood supply to railways was crucial in changing the extent of market induced exploitation and of the general integration of forests into a wider trade network. Sources indicate that the Railway department was the min purchaser timber from the Indian Forests. The expanding railway system meant increased demand for sleepers, not only to lay new tracks but also to re-lay old ones. Within the country there were 1,349 km of tracks in 1860, which increased to 7,678 in 1870, 25,495 in 1890, 56,980 in 1920-21 and 65,217 km in 1946-47. The total length of tracks in 1910 was 51,385 km for which the annual requirement of sleepers was 4 million.

Railway required not only sleepers but also fuel and timber for carriage and wagons. In areas which were distant from the source of coal, railway mainly used wood as fuel. There was a search for source of firewood. The forest department was allowed to cut fuel wood from forests along the tracts.

The Birth of Indian Forest Department

The Indian Forest Department originated in 1864 with Dietrich Brandis, a German botanist turned forester, as the first Inspector General of Forests. A hurriedly drafted Forest Act was passed in 1865 to facilitate the acquisition of forest areas earmarked for railway supplies. However the Indian Forest Act that is still largely in force came about only in 1878 after debate over the provisions. Certain states as the Madras presidency have been trying to obstruct the rapid revenue augmentation by achieving complete control over forest lands which they expressed dismay over the customary rights enjoyed by indigenous people.

Dietrich Brandis and the Indian Forestry

Brandis toured the presidencies and centrally administered provinces, laying down more specific duties for the forest services. In his nineteen years as Inspector General of Forests, Brandis produced several reports based on relentless travelling through the jungles which became the basis for creating forest administration with specific responsibilities in the provinces. These included forest settlement, demarcation, surveying and formally constituting state forest; preparation of working plans; construction of roads, bridge, buildings, drainage channels and anicuts. Protection work was directed against fire, cattle and natural calamities.

Evolution of forest Policy in Colonial India

In most provinces the Forest services was placed administratively under the Revenue department. The Forest service came to be regarded "as a purely commercial concernits chief reason for the production of revenue". This assertion was made proven based on an extensive survey of government documents in the last quarter of the 19th century. By 1920 net revenue from the state forest had increased fourfold to 21 million rupees, from 5.5 million rupees of 1880s. The Forest policy also made sedentarization project of the 19th century which sought to delegitimize the life and culture of local people of forest like Banjaras, Jhumias, Shikaris, Rangars, Bhattis, Mazhabis, Meenas, Mevs, Bhils and host of peoples who were itinerant traders, nomadic pastoralist, shifting cultivators and so on. The culmination of factors like rapid timber demand, growth of Railways and rise of mining, was lead to the passage of comprehensive Forest policy in colonial India. The forest act was passed in 1865. To further consolidate and legitimize their control over the forest, the British successively passed the Forest Act VII of 1878, amended by the Act V of 1890, Act XII of 1891, Act V of 1901 and Act XV of 1911.

Forest Act 1865

1865 Act empowered several local governments to declare certain area as State Forest without it any way interfering with the rights of the people. The forest act of 1865 49provided the legal sanction to the forest administration in various provinces of India and empowered the colonial state to acquire monopolistic control over India. It categorized the Indian Forest landscape into 'reserved forest' and 'unreserved forest', and urged the provinces to follow it. Most of the provinces accepted the Act but

the Madras Government opposed the implementation of the Act "on the ground that it would negatively affect the communal rights and privileges of the people". Most of the collectors of the presidency also opposed it. In spite of the rejection of the Forest Act of 1865 and the draft bill of 1869, the government of India continued to press upon for the forest legislation in the Madras presidency.

Forest Conference

To fix the proportion of balanced policy among the imperial and provinces forest policy, national conference was convened. Two conferences, one at Allahabad and the other at Simlan was held. Baden Powell argued in Allahabad conference that a very large proportion of forests were admitted to be the absolute property of the state. Another forest conference was held in Simla under the chairmanship of Dr. Brandis. Here many forest officials held the view that forests were public property and that they should be managed by the state for public welfare. The main theme of the legal debate was on the nature of people's rights in forest. The forest rights were inherently limited in nature and could only be exercised as long as the waste lands and forests provided the sources. The forest usage in India existed in the form of user rights but not as property rights.

1878 Forest Act

The first attempt at asserting state monopoly right was through the Indian Forest Act of 1865, which was replaced by a much more comprehensive piece of legislation 13 years later. The provisions of the 1878 act ensured that the state could demarcate 'valuable tracts of forest, needed especially for railway purposes and retain enough flexibility over the remaining extent of forest land to revise its policy from time to time. Monopoly right was established by a legal sleight of hand, which sought to establish that the customary use of forest by the villagers was based not on right but on privilege and this privilege was exercised only at the mercy of the local rulers.

War effects on Forest Policy

The two world wars saw India's Forest policy paradigm shift for the profound impact in the colony. During the World wars the optimum value of India's Forest for the Empire was fully realized. Every possible ways were extracted to substitute indigenous timbers for imported ones. Indian Timber and other types of woods were supplied for construction of bridges,

piers, wharves, buildings, railway lines and ships. In a year (April 1917 to October 1918) 228,076 tons of timbers (excluding railway sleepers) were supplied by the exclusively created new branch called "Timber Branch" of the war department munitions Board. Approximately 1.7 million cubic feet of timber (almost Teak wood) were exported annually between 1914 and 1919 and the indigenous resin industry was in a great demand at a time when American and French supplies were unavailable. The impact of the Second World War was more severely felt on the Indian Forests. In 1940 a Timber Directorate was set up in Delhi to channel supplies of Forest produce from the provinces. Forest resources from India were the sole supplier of timber to the Middle Eastern parts of war and later on in Iraq and the Persian Gulf region.

2.12 Conclusion

The aggregate impact of the forest policies followed by Colonial administration in India is proven by the hasty deteriorating stock of woods officially called as reserved forests. Forest were a strategic raw materials harnessed for the imperial interests such us railway expansion and for civil engineering purposes. Forests began to be opened up for a large-scale wood extraction in colonial India leads to large scale deforestation. Increased demand for timber by the railways and the Public Works department demanded the bureaucracy to take over forest management. The consequences of all these processes through Imperial Forest policies and acts, controlled and monopolistic trade practices on Indian Teak at the expenses of natural forests massively during the colonial period. In the context of colonial exploitation the process deforestation in India have to be comprehended.

2.13 Let us sum up

As a part of the Human evolution and civilizational outcomes nature and natural recourses were harnessed to need and demands of humans. Till the emergence of organized society and state, the damage to the nature and environment was meager and scanty. Once the state was established, natural resources in particular forests were coupled with revenue generation concept. The multiple effects on natural resources largely felt in the mutilations of forest coverage for various reasons. The primary reasons for the extraction of forest resources were mainly with timbers for ship building purposes. Age of Enlightenment and Post

Industrial revolution has led to the birth of colonialism and paved the way to western influence on third world countries. India as a colony was the main country has lost it major forest resources for the European demand.

2.14 Self-Assessment

1. Explain the Neolithic culture impacts on Environment.
2. Write the nature of Pastoralism and environmental degradation.
3. Bring out the environmental causes for the decline of Civilization.
4. Summarize the impacts of deforestation and the decline of Indus valley civilization.
5. Explain the description of forest during Mughal India.
6. Describe the linkage between tribal culture and domicile forest regions.
7. Evaluate the forest policies of British India.
8. Extract the implications of Colonial Forest act towards deforestation in India.
9. Describe the evolution of forest policy of Colonial India.
10. Bring out war effects on Indian Forest policy.

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UNIT - III

Lesson 3.1 - Social Issues and Environment

Structure

3.1 Learning Objectives

The main objectives of this unit are

1. To synchronize the influencing factors between social ecology and sustainable development
2. To describe the major concerns and priority factors of sustainable development

3. To discuss the issues debated in sustainable development
4. To enable the learners to understand the multiple dimensions of sustainability
5 To corroborate the achievements of sustainable development

Keywords

Social Ecology, Environmental Crises, Political Economy, Sustainable Development, Global Ecology, Population & Poverty, Climate Change, Bio-diversity, Renewable Energy.

3.2 Introduction

The Environment comprises three vital components. The components are the Nature, the man- made and the social relations. They exist in a mutual causal relationship and function as determinant of human life. Industrialization as a social development is the direct and main cause of the emerging natural and social environmental problem. The industrialization has brought urbanization. Natural environment problems have emerged directly from industrialization. Social environmental problems and the result of urbanization have also accompanied industrialization. Industrialization and unpolluted natural environment are important for human beings. In other words the environment is important because the crisis of the environment is the crises of human life.

The emergence of Social Ecology

The term 'ecology' refers to the study of relationship between living beings and their environment. The 'social ecology, is the study of interactions between human beings and the environment and how these interactions have a reciprocal impact on the society and the environment. It is an interdisciplinary approach to study, 'the interrelationship between human social institutions and ecological or environmental issues'. The environment is important for human beings in that it determines the way human action is done as well as function as determinant of the quality of human life. During 1930s a branch of Sociology, Social ecology emerged. The Social ecology focused on the relationship between environment and human life. The principle of social ecology was based on three aspects. First humans are not so immediately dependent upon the natural environment, have been emancipated by the division of labour. Second, technology has allowed humans to remake their habitat and their world rather than to be

constrained by it. Third, the structure of human communities is more than just the product of biologically determined factors; it is governed by cultural factors notably an institutional structure rooted in custom and tradition. P.A. Kropotkin, Murray Bookchain, Jacques Elisee, Teclus, Patrick Geddes and Lewis Mumford are few names associated with the emergence of Social Ecology as an interdisciplinary approach to understand the dynamics of human interrelationship with environment.

3.3 Environmental Crisis and Social Concerns

The environmental crises in its various aspects (climate change, pollution, resource depletion, habitat loss and species extinction) leads a fundamental threat to humanity and to the global ecology. Reciprocal to this crisis will require a comprehensive strategy. 'Environment', the problem of ecological survival', 'sustainable development' is the catchy phrases in global and national level. In India, attention towards the importance in the field of ecology and environment is corresponds with the emergence of the environmental movement. Environmentalism in India understood through two different phases. The first phases witnessed in interwar years were writers foregrounded on the ecological infrastructure of India. Radhakamal Mukherjee was one such writer who is considered as the pioneer of Indian Ecological study. The second phase emerged during 1970s as consequences of post-independence concern with Industrialization to tune with the developed world relegated environmental concern.

3.4 Liability of Political Economy and Public Policy Bodies

Responding the environmental crises in its various aspects require a comprehensive strategy. These strategies are to comprise sustainability, green policies necessary to draw on theoretical frameworks and tool dedicated to achieve a genuine environmental sustainability. Political Economy is a branch of the social science that analyzes how socio-economic activities are regulated, underlining the reciprocal influences among economic, social and political factors. Genuine environmental sustainability demands a dynamic political economic paradigm for both environmental sustainability and social justice. New Political Economy should empathizes of how humans can produce the need of life and reproduce themselves and their social relationships, in ways that support the existence and flourishing of other species and the ecological health of the biosphere. Public policy matters towards enabling an authentically

sustainable society. It is like 'theory to practice and it is important to outline specific public policy measures that could provide practical means to sustainability. The formulation and implementation of progressive public policies wanted to be integrate the goals of social justice and environmental sustainability.

3.5 Introduction to Sustainable Development

According to United Nation knowledge repository Sustainable Development defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainable development calls for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet. For sustainable development to be meeting, it is imperative to synthesis three major elements: (i) economic growth, (ii) Social inclusion and environmental protection. These elements are interconnected and are vital for the well-being of individuals and groups.

Sustainable development widely adopted as a policy objective by institutions, governments, business, non- governmental bodies and others. 'Ensuring environmental sustainability' is one of the UN's Eight Millennium Development Goals. It articulates that ' the community shall have as its task….. to promote a harmonious, balanced and sustainable development of economic activities….and further it states ' Environmental protection requirements must be integrated into the definition and implementation of the community policies and activities referred in particular with a view to promoting sustainable development'. The challenges facing the earth today, mainly climate change, the sustainable development as a policy tool address the fact that there are limits to the earth's resilience and people's moral failure to contain over consumptions. The demands of the twenty first century need more dynamic sustainable development exploring the importance and emergence of 'ecological sustainability' as the moral and public policies underpinning the concept of sustainable development. The climate change agenda became the focal point towards building better ecological sustainable world.

3.6 Evolution of the Concept Sustainable Development

World Commission on Environment and Development The universal definition of sustainable development is that 'development

that meets the needs of the present without compromising the ability of future generations to meet their own needs. The World Commission on environment and Development first met in October 1984, and published its report in April 1987. There was realization in national governments and multilateral institutions that it is impossible to separate economic development issues from environment issues. Many forms of development erode the environmental resources and environmental degradation undermines economic development. Poverty is a major cause and effect of global environmental problems. These concerns were behind the establishment in 1983 of the World Commission on Environment and Development by the United Nations General Assembly. The commission's mandate gave it three objectives

1. To re-examine the critical environment and development issues and to formulate realistic proposals for dealing with them.
2. To propose new forms of international cooperation on these issues that will influence policies and events in the direction of needed changes.
3. To raise the level of understanding and commitment to action of individuals, voluntary organizations, institutions and governments.

Sustainability and Development

Sustainable development should integrate social, environmental and economic sustainability. The moment the term development comes along with degradation of resources, invasion of land use topographical modifications and biodiversity depletion. The Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

3.7 Two key paradigms of Development

Development involves a progressive transformation of economy and society. A development path that is sustainable in a physical sense could theoretically pursue even in a rigid social and political setting. But the physical sustainability cannot be secured unless development policies pay attention to such considerations as change in access to resources and in the distribution of costs and benefit. The satisfaction of human needs and aspirations is the major objective of Development. The essential needs of vast number of people in developing countries for food, clothing, shelter and jobs are not fully met, and beyond their basic needs the people have legitimate aspirations for an improved quality of life.

- The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given and
- The idea of limitations imposed by the state of technology and social organisactions on the environment's ability to meet present and future needs.

Thus the goals of economic and social development must be defined in terms of sustainability both in developed or developing countries.

3.8 The Concepts of Sustainable Development

"A world in which poverty and inequity are endemic will always be prone to ecological and other crises". Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for better life. Meeting essential needs depends in part on achieving full growth potential and sustainable development requires economic growth in place where such needs are not being met. The content of Economic growth reflects the board principles of sustainability and nonexploitation of others. Hence sustainability development requires that societies meet human needs both by increasing productive potential and by ensuring equitable opportunities for all.

3.9 Scope of Sustainable Development Concept

- The growth expansion in numbers can increase the pressure on resources and slow the rise in living standards and deprivation is widespread. Sustainable development can only be pursued if demographic developments are in harmony with the changing productive potential of ecosystem.
- The society may in many ways compromise its environment to meet the essential needs of its people by over exploiting resources and technological developments may solve some immediate problems but lead to even bigger limitations. Large sections of the population may be marginalized by illconsidered development.
- Settled agriculture, the diversion of water resources, the extraction of minerals, the emission of heat and noxious gases into the atmosphere, deforestation and genetic manipulations are all examples of human intervention in natural systems during the course of development. These interventions was very minimal until recently the world witnessed the boom of Industrial and technological development.

- In the world of 21st century human's interventions towards environment are more drastic in scale and impact, and become more threatening to the ecosystems both locally and globally. At a minimum, sustainable development may contain and not endanger the natural system that supports life on earth.
- Growth has no set limits in terms of population or resource use beyond which lies ecological disaster. The accumulation of knowledge and the development of technology enhance the carrying capacity of the natural resources. But ultimate boundary limits are there and sustainability requires that long before the exhaust limits are reached. The principle of sustainability will ensure equitable access to the constrained resources and reorient technological efforts to relieve the pressure.
- Ecological growth and development involve changes in the physical ecosystem. Every Ecosystem cannot be preserved intact. In general renewable resources need not be depleted provided the rate of use is within the limits of regeneration and natural growth. But non- renewable resource are part of a complex and interlinked ecosystem, sustainability will be the right approach in this regard to reap maximum yield after taking into account system wide effects of exploitation.
- Sustainable development requires that the rate of depletion of non-renewable resources should foreclose thus the stock available for future generations will be guaranteed.
- Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.

3.10 Major Concern of Sustainable Development

How can development serve next century's world as many people relying on the same environment? This question became a serious challenge among the policy makers and institutions both nationally and globally. This realization broadened the view on development. New development path was required, one that was the Sustainable Development. Thus sustainable development becomes a goal not just for the developing nations but for developed ones as well. The sustainable solutions can be addressing the

following broadening areas were maximum environmental depletion and disturbance of ecosystem was felt.

1. The interlocking crises
2. The institutional gaps
3. Human Resources (Population)
4. Sustaining the Potential (Food Security)
5. Resources for Development
6. Energy: Choices for environment development
7. Production more with less (Industry)
8. The Urban challenge.

The Interlocking Crises (Global Economy vs Global Ecology)

(i)Multifold Consumption: The Planet is passing through a period of dramatic growth and fundamental change. Economic activity has multiplied to create economic growth. Industrial production has grown more than fiftyfold over the past century, four-fifths of this growth since 1950. Such figures reflect and presage profound impacts upon the biosphere as the world invests in houses, transport, farms and industries. Much of the economic growth pulls raw material from forests, soils, seas and waterways.

(ii) Technology: The mainspring of economic growth is technology. This technology fastens the dangerously rapid consumption of finite resources. It also entails high risks, including new forms of pollution. The industrial consumption most heavily reliant on environmental resources and most heavily polluting are growing most rapidly in the developing world.

(iii) Environmental Management: International economic relationships pose a particular problem for environmental management. Agriculture, forestry, energy production and mining generate at least half the gross national product of many developing countries and account for even larger shares of livelihoods and employment. Exports of natural resources remain a large factor in nation economies, especially for the least developed. Most of the developing countries face enormous economic pressures, both international and domestic to over exploit their environmental resource base.

(iv) Poverty & Unemployment: The majority of developing countries have low per capital incomes. Rising poverty and unemployment have increased pressure on environmental resources as more people have been forced to

rely more directly upon them. The developing governments have cut back efforts to protect the environment and to bring ecological considerations into development planning.

These related changes have locked the global economy and global ecology together in new ways. The past has been concerned about the impacts of economic growth upon the environment. Whereas the present situation forced to concern the impacts of ecological stress- degradation of soils, water, atmosphere and forests upon other economic prospects. The present been forced to face up to a sharp increase in economic interdependence among nations. The recent present forced to accustom to an accelerating ecological interdependence among nations. Ecology and economy are becoming ever more interwoven- locally, regionally, nationally and globally into a seamless net of causes and effects.

The present efforts to guard and maintain human progress to meet human needs and to realize human ambitions are simply unsustainable. They draw too heavily, too quickly on already overdrawn environmental resource accounts. They may show profits on the balance sheet of our generation, but the future generation will inherit the losses. The current world borrows environmental capital from future generations with no intention or prospect of repaying.

2. The Institutional gaps

The integrated natures of the global environment / development challenges pose problems for institutions to both national and international. Most of the time governments' policies were prospects towards narrow pre occupations and compartmentalized concerns. Governments' general response to the speed and scale of global changes has been a reluctance to recognize sufficiently the need to change themselves. The challenges are both interdependent and integrated, requiring comprehensive approaches and popular participation. There is a growing need for effective international cooperation to manage ecological and economic interdependence. The other great institutional flaw in coping with environment/ development challenges is governments' failure to make the bodies whose policy actions degrade the environment responsible for ensuring that their policies prevent that degradation.

3. Human Resources (Population)

In many parts of the world, the population is growing at rates that cannot be sustained by available environmental resources. The issue is not just numbers of people, but how those numbers relate to available resources. The population problem must be dealt with in part by efforts to eliminate mass poverty, in order to assure more equitable access to resource and by education to improve human potential to mange those resources. Human resource development is a crucial requirement not only to build up technical knowledge and capabilities but also to create new values to help individual and nations cope with rapidly changing social, environmental and development realities.

4. Sustaining the Potential (Food Security)

Every year there are more people in the world who do not get enough food. Global agriculture has the potential to grow enough food for al, but food is often not available where it is needed. Food production in industrialized countries has usually been highly subsidized and protected from international competition. These subsidies have encouraged the overuse of soil and chemicals, the pollution of both water resources and foods with these chemicals and the degradation. Meantime food security requires attention to questions of distribution, since hunger often arises from lack of purchasing power rather than lack of available food. It can be furthered by land reforms, and by policies to protect vulnerable subsistence.

5. Resources for Development

There is a growing consensus that natural resources including species are disappearing at rates never before on the planet. The diversity of species is necessary for the normal functioning of ecosystems and the biosphere as a whole. A first priority is to establish the problem of disappearing species and threatened ecosystems on political agenda as a major economic and resource issue. Governments can stem the destruction of tropical forest and other reservoirs of biological diversity while developing them economically. Government should investigate the prospect of agreeing to a species convention similar in spirit and scope to other international conventions.

6. Energy: Choices for environment development

The industrialization, agricultural development and rapidly growing populations of nations will need more energy. The planetary ecosystem could not stand this, especially if the increases were based on non-renewable fossil fuels. Threats of global warming and acidification of the environment most probably doubling of energy use based on present mixes of non-renewable sources. Energy efficiency policies must be the cutting edge of national energy strategies for sustainable development. Energy efficiency can only be the solution for the world to develop low- energy paths based on renewable sources which should form the foundation of the global energy structure of 21st century. To achieve this height will require coordinated research, commanding funding to ensure rapid development of renewable energy. A safe, environmentally sound and economically viable energy pathway that will sustain human progress into the distant future is clearly imperative. Clean energy as a choice for development is the solution for the sustainable priority in respect towards energy sector.

7. Production More with Less (Industry)

Manufacturing output and raising world consumption of manufactured goods increased to tenfold proportionate to the population growth. While economic growth has continued, the consumption of raw materials sterns with environmental damage could not be avoided. Nations have to feel the costs of any inappropriate industrialization and many developing nations are realizing that they have neither the resources nor rapid technological change; the only instant remedy is time to damage their environment. Emerging technologies too comes with increased efficiency and decreased pollution, but many bring risks of toxic wastes which damages the environment beyond retrieval and reconciliation. Many essential human needs can be met only through goods and services provided by industry and the shift to sustainable development must be powered by a continuing flow of wealth and less environmental degradation.

8. The Urban Challenge

The world of the 21st century is largely a urban world. Over the years, the developing world's urban population has increased tenfold from around 100 million in 1920 to 1 billion today. Few city governments in the developing world have the power, resources, and trained personnel to provide their rapidly growing populations with the land, services

and facilities needed for an adequate human life. In the developing and third world countries settlement with primitive facilities, increased overcrowding and rampant sanitation and sewage conditions linked to unhealthy environment. Many cities in industrial countries facing the problems like deteriorating infrastructure, environmental degradation. Governments need to develop explicit settlements strategies to guide the process of urbanization, taking the pressure off the largest urban centres and building up satellite towns and cities. For good city management requires decentralization of funds, political power to local authorities which are best placed to appreciate and manage local needs. The sustainable development of cities will depend on closer work with the majorities of urban poor who are the true city builders, tapping the skills energies and resources of groups and informal sector.

3.11 Sustainability: The Guiding Principle

The guiding principles of sustainability cut across ecological, economic, social and cultural dimensions.

a). Inter- generational equity: providing for today while retaining resources for tomorrow.

b). Conservation of cultural and biological diversity and ecological integrity.

c). Precautionary policy approach to resources use.

d). Resources use in manner that contributes to equity and social justice.

e). Limits on natural resources use within the capacity of the environment.

f). Qualitative rather than quantitative development of human wellbeing.

g). Pricing of environmental values and natural resources to cover environmental and social costs.

h). Efficiency of resources use by all societies.

i). Strong community participation in policy and practice during the process of transition to an ecologically sustainable society.

The best way to approach sustainable development is through an understanding of the linkages between the ecological and social processes at different dimensions. Organization of local communities through a

bottom-up approach would ensure that each stakeholder take part in the decision- making process at the lowest level in the hierarchy.

3.12 Issues Debated in Sustainable Development

Introduction

The World Commission on Environment and Development presented its report to the world at a press conference in London, on 27 April 1987. The report examines the critical issues of environment and development, suggests concrete and realistic proposals for dealing with them and proposes far-reaching changes for implementing the proposals at national and international level. It is a major report that ranges over the many challenges and issues to the planer brought by both under and overdevelopment. It recommends at strategies for countering these threats at the institutional changes needed for the successful development of these strategies. Sustainable development emphasizes the process by which people satisfy their needs and improve their quality of life while safeguarding the ability of the future generations to meet their own needs. Each year the number of human beings increases but the amount of natural resources with which to sustain this population to improve the quality of humans lives remains finite

Population & Poverty

Poverty must surely be one of the most important of the problems associated with Sustainable development. There are more people hungry in the world today than ever before and the absolute numbers are growing daily. The numbers of people living in slums and shanty towns and the numbers lacking access to clean water and sanitation continue to rise. Most of the world poorest countries depend heavily on the export of primary tropical agricultural products, the prices to a large extent controlled by the market system of the industrial world. Fluctuating and often declining prices hamper efforts to diversify the economics of poor nations and leave little spare capital for environmental considerations.

India's Population

The population of the country as per the figures of Census 2011 is 1210.19 million. India with 2.4 % of the world surface area accounts for 17.5 % of its population. India is more densely populated than china

which has three times land space of India. Under the guidance of UN , Government of India assessed the impact if population explosion on the natural environment and the existing state of environmental problems. The fifth five year plan (1974-79) empahasizes that the pursuit of development goals would not be less likely to cause a reduction in the quality of life if life a link and balance between development planning and environmental management was maintained. Minimum needs programme concerning rural and elementary education, rural health and sanitation, nutrition, drinking water, provision for housing sites and slum improvement received a fairly high priority and was expected to reduce and minimize environmental pollution and degradation in rural areas and reduce poverty levels. The Seventh five year plan (1985-1990) emphasize sustainable development in harmony with the environment, as the plan recognized the negative effects that development programmes were having on the environment. It was realized that poverty and underdevelopment as opposed to development activities had led to many of the country's environmental problems, and such problems could no longer be side-lined. Reduction in population growth has been recognized as one of the priority objectives for achieving socio- economic development right from first year plan to tenth five year plan. The issue of population stabilization has also been recognized as an essential requirement for promoting sustainable development in National Population Policy 2000. The state of India's ecological balance is now in crisis. The balance of nature is being disturbed by cutting down forest, indiscriminately converting grasslands into areas of human habitation. India's natural resources are under intense pressure. The challenges of their conservation and sustainable use remain enormous. The availability of renewable fresh water in India fell from around 6000 cubic meters per head a year in 1947 to 1600 cubic meters in the year2017. The over exploitation of groundwater is emerging as an increasingly serious problem in the country. Soon India will be 'water stressed' because water availability is drastically going down.

India's response

From the point of view of population control 42 amendment has added a new entry 20A entitled 'population control and family planning' to the list III to the 7th schedule to the constitution. The parliament enacted the water prevention and control of pollution Act 1974 for the control of pollution of water. The Air prevention and control of pollution Act 1981 was passed by parliament for the preservation of quality of air

and control of air pollution. The Environment Act 1986 was enacted for a wider purpose of protecting and improving the human environment. The judiciary in India has also played a very important role in the environmental protection and has created a new environmental jurisprudence. The court have applied the principle of sustainable development to the cases relating to quarrying, mining, stone crushing and hazardous industry.

Climate Change

Climate change is one of the most debated sustainable development challenges with intense implications for food production, water supply, health and energy. The projected climate change is likely to have implications on food production, water supply, coastal settlements forest ecosystem, health, energy security. According to the latest scientific assessment, the earth's climate system has drastically on both global and regional scales since pre-industrial era. The inter-governmental Panel on Climate Change (IPCC) estimated that the global temperature may increase between 1.4 and 5.8 degree Celsius by 2100. This increase is expected to have severe damages on the global ecosystems, sea level and crop production. The climate change issue is part of the larger challenge of sustainable development. The impact of climate variability and change, climate policy response associated with socio-economic development.

Factors responsible to Climate Change

The global carbon cycle involves interaction among the atmosphere, Oceans, soil, vegetation and fossil fuel deposits. The combustion of fossil fuels and other human activities are the primary reasons for increased concentrations of carbon di oxide and other Greenhouse gases. Controlling the release of greenhouse gases from fossil fuel combustion, land use change and the burning of vegetation are the obvious chances for reducing greenhouse gas emissions.

Impacts of Climate Change

Developing countries are faced with immediate concerns that relate to forest and land degradation, freshwater shortage, food security and air and water pollution. Climate change will multifold the impacts of deforestation and other economic pressures leading to further water shortages, land degradation and desertification. Increasing global temperatures will result in raising sea levels. Populations that inhabit small islands and low-lying coastal areas are at particular risk of severe social and economic disruptions.

India's response

Sustainable development has become part of all climate change policy discussions at the global level. The adoption of Agenda 21 and the various Conventions resulting from the UNCED (United Nations Conference on Environment and Development) has highlighting the relevance and ration of SDs. Sustainable development has become an integrating concept embracing economic, social and environmental issues. Three critical components in promoting sustainable development are economic growth, social equity and environmental sustainability. India has completed four nationally coordinated assessments of climate change projections, impacts and mitigations. The first on the climate change studies supported by Asian Development Bank, the second being on Asian Least –Cost Greenhouse Gas Abatement Study supported by the Global Environment Facility. The third being on Climate impact assessment study conducted under the Indo- UK collaborative project and latest being the National Communications supported by the Global Environment Facility. The national Communications was one of the successful national level coordinated efforts involving 131 teams from research and educational institutions, covering all the three aspects of climate change; climate projections, impacts and adaptation and mitigation.

Biodiversity Degradation

Biodiversity means variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes, which includes diversity within species of ecosystems. Indian subcontinent forms part of the 25 mega diversity hotspots of the world. India is a signatory to the United Nations Convention on Biological Diversity signed at Rio de Janeiro in 1992.

India's Response

India at the national level formulates a multidimensional biological diversity conservation policy includes in consultation with State governments, Institutions of local Self- Governing organisations and industry. The Biological Diversity Act 2002 is landmark in the environment and development field. It is a very comprehensive approach being taken for the first time towards the conservation of earth's biodiversity and sustainable use of its biological resources. This act for biodiversity conservation bears policy guidelines that balance biodiversity conservation and sustainable development and warrant self- governance of bio resources utilization.

Agriculture and Sustainable Development

Throughout the world agriculture is under pressure to develop as a more sustainable economic activity. In developed countries agriculture production conflated with wider concern over food health and food quality, whereas in developing countries poverty and population pressure factors resulted into maximum extraction of soil, water and natural resources. Agriculture's impact on the environment and food security is hot topic. Agriculture, forestry and fisheries are traditional activities in the rural environment of India. The causes of unsustainable agricultural development are the negative impacts on the environment, economy and society. Unsustainable agriculture is commonly traced to period of farming development or otherwise termed as 'productivism'. Intensification of agri-inputs through new technologies for fertilizers, agri chemicals and farm machinery had increase in outputs per hectare of farmland of both crops and livestock products. The negative impacts of these processes in creating a model of agricultural development look unsustainable. Loss of biodiversity (wetland, moorland and forest), the nitrification (pollution) of groundwater and eutrophication of watercourses from the use of inorganic fertilizers associated with increase in arable land, rising levels of soil erosion and salinity.

India's Response

A range of proposals for alleviating the environmental crises and a challenge to sustainable development in Agriculture sector are emerging. Alternative agricultures covers a range of philosophies on sustainable farming, including ecological biodynamic, low external input, permaculture, biological resources conserving and regenerative systems. These wide ranges of initiatives were adopted as policy matters both in union and local level in India.

Renewable Energy and Sustainable Development

A Sustainable energy system is mainly based on its energy efficiency, reliability and environmental impacts. Energy security of supply and availability, energy pricing renewable energy sources facilitates sustainable energy future. Unsustainable energy activities are chief emanates of air pollution, acidification and global warming. These conventional non- renewable energy productions produce 85% of anthropogenic emissions of sulfur dioxide and 78 % of Carbon- di-oxide

and 23 % of methane of greenhouse gas emissions. Sustainable competitive and secure energy at affordable prices from renewable energy are crucial for sustainable development in the energy sector. Underproduction of renewable energy is one of the toughest challenges in the prospects of sustainable development. It seems the world yet to persuade about the importance of renewable energy to solve the problem of energy security and sustainable development. Renewable energy based green power policy is still considered expensive path for development, policy makers remain hesitant to take target-based approach to increase green energy supply in the total energy production.

Major types of renewable energy

Renewable energy comprises a wide range of technologies including self-renewable energy sources such as sunlight, wind, flowing water the earth's internal heat and biomass which are utilized in the production of electricity for all economic sectors, transportation fuels and heat for buildings and industrial purposes. Thermal power plants, Small Hydro, Wind mills, Biomass, Solar PV and waste to energy are the major types of sources for energy production in inclined with renewable sources. Wind, solar and geothermal sources emit with zero or almost zero waste and pollutants which causes acid rain, smog and health problems and global warming. Renewable energy can be treated as context neutral strategic solution for sustainable development. Continued promotion of renewable energy is indispensable for Sustainable based development.

India's Response

According to a recent United Nations report India's increase in the size of the population resulting into a corresponding burden on the governments to provide basic infrastructure and utilities. India imports 80% of its crude oil and 18% of its natural gas, totaling an import bill of 150 billion US dollars and making India as the 4th largest importer of oil and petroleum products. To combat this issue, Government of India made investments in the renewable energy sector through a mix of financial incentives and subsides. India managed to generate 35.77GW energy in the renewable energy sector. Recently the Government of India came out with the draft National Renewable Energy Act 2015 released by the Ministry of New and Renewable Energy. The rationale behind the enactment of this act seems to two objectives. First to increase the quantity of energy generated through renewable energy sources thereby reducing the dependence on

fossil fuels and other traditional forms of energy resources, ultimately leading to a reduction in imports and promoting India's energy security. Secondly to promoting renewable energy in India is also in consonance with the Government of India's international obligations to reduce emissions of carbon dioxide and other greenhouse gases.

Urbanization

In the 21st century, almost half of the world lives in urban areas from small towns to huge megacities. The world's economic system is increasingly an urban one with overlapping networks of communications, production and trade. This century is rightly called as 'urban revolution'. In many developing countries, cities have grown far beyond anything imagined. In most third world country's cities, the enormous pressure for shelter and services has jeopardized the urban fabric. Much of the housing used by the poor is decrepit. Civic buildings are in a state of disrepair and advanced decay. Essential infrastructure like public transport is overcrowded and overused. Water supply systems leak and the resulting of low water pressure allows sewage toseep into drinking water. A large proportion of the city population often has no piped water, storm drainage, or even roads. A growing number of the urban poor suffer from a high incidence of diseases; most are environmentally based and could be prevented through relatively adopting sustainable strategies. Air, water, noise and solid waste pollution problems have increased rapidly and can have dramatic impacts on the life and health of city inhabitants on their economy and on jobs. Out of India's 3119 towns and cities, only 209 had partial and only 8 had full sewage treatment facilities. On the river Ganges, 114 cities each with 50,000 or more inhabitants dump untreated sewage into the river every day. The Hoogly river near Kolkata is choked with untreated industrial wastes from more than 150 factories around Kolkata. Motor vehicles greatly influence environmental conditions in the cities.

3.13 Key Goals Settings to Sustainable Urbanisation

The United Nation's Sustainable Development Goals (SDG) lay down some guiding principles for urban planning design and management which have to meet by 2030.

(a) Reduce adverse per capita environmental impact in cities. This seeks special attention to air quality and municipal and other waste management.

(b) Reduce the number of deaths and illnesses from hazardous chemicals

an air, water and soil pollution and contamination.

(c) Strengthen the capacity for early warning, risk reduction and management of global health risks.

(d) Envision that there should be safe access to affordable, accessible and sustainable transport systems for all in cities by improving and expanding public transport with the special attention to the needs of those in vulnerable situations. Women, children, persons with disabilities and older persons.

(e) Aim for inclusive and sustainable urbanisation and building a capacity for participatory, integrated and sustainable human settlement planning and management.

(f) Envision cities and human settlements to adopt and implement integrated policies and plan towards inclusion, resource efficiency, mitigation and adaptation to climate change and resilience to disasters.

(g) Upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmental sound technologies and industrial processes.

India's Response

The government of India has adopted the SDGs to stimulate, align and accomplish action by 2030 in areas of critical importance. The SDGs are being integrated with the central policies and schemes. State governments are also aligning their visions and plans with the Goals for implementation. Out of the 17 Goals, several have a direct bearing on sustainable urbanisation. In 2016 came the New Urban Agenda, the global vision of sustainable urbanisation, an outcome document of UN Conference on Housing and Sustainable Urban Development –UN Habitat III. This agenda recognises urban spaces and cities as the focal points of development, and is linked with social inclusion, accessibility, urban prosperity and safe and affordable housing.

The key actions listed includes

(a) reducing water and electricity use by 50 percent

(b) enabling over 60 percent of urban travel by public transport

(c) generating half the power from renewable sources

(d) promoting walking and cycling for last mile connectivity

(e) compact and cluster urban development

(f) Promoting natural drainage patterns

(g) Reducing waste generation of all kinds

(h) Promoting greenery and public places

(i) Construction of houses for the urban poor.

The UN Habitat III talks about the "Right to City" – indicative of collective rights of all inhabitants, irrespective of their legal status over the city's resources and space. This is an integral part of sustainability. Government of India have come with The Guidance Framework has integrated and aligned with the a wide gamut of central and state level policies relates to resources conservation and efficiency, waste management and recycling, pollution and mobility management, energy efficiency and renewable energy and environment clearance requirements and protection of biodiversity.

The Government of India also adopted policies align towards the existing international standards related to Urbanisation with sustainability. These include

(a) the smart city programme

(b) renewable energy targets and solar city provisions

(c) National Urban Transport Policy

(d) National habitat Standards

(e) Transit oriented development policy

(f) Decentralized environmental clearance procedure for buildings

(g) Energy conservation Building code

(h) Air quality standards and regulations

(i) National climate action plan

(j) Solid waste management rules and regulations

(k) Construction and demolition waste rules and regulations

Several of these objectives are backed by legislation to make them legally binding. This Guidance Framework and action agenda underscores that each of the stakeholders has a shared responsibility to deliver on the sustainability goals. The environmental sustainability will ensure inclusiveness and equity.

3.14 Basic Aspects of Sustainability

Sustainability is defined as "meeting human needs in a socially just manner without depriving ecosystems of their health". Sustainability could mean anything from "exploit as much as desired without infringing on the future ability to exploit as much as desired. Achieving sustainability has become a central issue of our time. A sustainability perspective is about ethical, economical, ecological and sociological. The framework arising from this definition is composed of five critical dimensions.

Five basic dimensions of Sustainability

(a) Development of efficient prospects and practice for meeting human needs, which is generally the purview of engineering, physical science, biotechnology, economics and business.

(b) Understanding the state and nature of ecosystems which is generally the purview of ecology and environmental sciences.

(c) Understanding how exploitation affects environment which is generally the purview of applied ecological science.

(d) Understanding how exploitation affects human cultures which are generally the purview of sociology, political science, and anthropology and the arts and humanities.

(e) Understanding the meaning of normative concept such as human needs, socially just, depriving which is generally the purview of ethics and philosophy.

Sustainability is essentially the relationship between the environment and society. That relationship involves a physical aspect (exploitation) and an ethical attitude (higher order thinking). The relationship is affected by five factors.

(a) Our technologies to extract and harness the environment

(b) Understanding of the environment

(c) Understanding how exploitation affects the society

(d) Understanding how exploitation affects the environment

(e) how we understand our ethical attitudes about ourselves and nature.

History provides plenty of evidence of the technologies and understandings towards how exploitation affects the environment are inadequate for achieving sustainability. The ethical perspectives are a

critical aspect of any relationship involving humans in the dimensions of sustainability.

Sustainability as a basic concept of modern day survival after multidimensional threats surface the 21st century. Sustainability core philosophy revolve are the idea of meeting the needs of the present without compromising the ability of future generations. Basic core principles of Sustainability as follows

(a) Environmental Sustainability

(b) Economic Sustainability

(c) Social Sustainability

(d) Cultural Sustainability

(a) Environmental Sustainability

Environmental sustainability comprises three vital areas. One is resource conservation, two biodiversity and ecosystem and third climate stewardship.

Conservation of resources

This involves using natural resources like water, energy and other natural raw materials efficiently to minimize waste and environmental degradation. This aspect focuses on the responsible use and management of natural resources such as water, energy, forests and minerals to ensure that they are available for future generations. It also includes the reduction of pollution and waste.

Biodiversity and Ecosystem

Environmental sustainability also involves protecting and preserving ecosystems and biodiversity. This includes efforts to prevent the extinction of species and the degradation of natural habitats. It also aims to protect and preserve the diversity of life on earth and maintain the health and resilience of ecosystems.

Climate Stewardship

An important percepts of Environmental sustainability, it focuses on reducing greenhouse gas emissions and mitigating climate change impacts through measures like using renewable energy and adopting sustainable practices.

(B)Economic Sustainability

Long term viability

Economic sustainability emphasizes the need for economic systems and activities that can persist over the long term. It involves strategies that promote economic growth while considering the potential impacts on resources and future generations. Economic Sustainability encouraging economic practices that is resilient, diverse and capable of maintaining stability and growth over the long term.

Innovation and Efficiency

Encouraging the development and adoption of technologies and practices that will enhance productivity and reducing negative environmental and social impacts.

Equity and Fairness

Economic sustainability also concerns with ensuring that the benefits of economic activities are inclusive in nature and distributed fairly among different groups in society, minimizing economic disparities and social injustices.

C. Social Sustainability

Equity and Social Justice

Ensuring that all individuals have access to basic needs, opportunities and resources regardless of factors like the race, gender, socioeconomic status and geographic locations.

Community Well-being

Community well-being otherwise known as Social sustainability promotes health, safety and overall quality of life within communities, including access to education, healthcare and cultural resources. Social sustainability focuses on the quality of life for current and future generations. It includes factors such as access to education, healthcare, safe housing and cultural and recreational opportunities.

Human Rights and labour practices

Upholding fair labour standards, ethical working conditions and respecting the rights and dignity of workers are the inalienable factors of Social Sustainability.

Social Justice

Social Sustainability also comprises promotion of gender equality, social cohesion and social justice.

(D)Cultural Sustainability

Preservation of Cultural Heritage

Protecting and celebrating diverse cultural traditions, languages and practices that enrich communities and contribute to a sense of identity.

Cultural Diversity and Inclusion

Fostering an inclusive society that respects and values different race, linguistic, religious and ethnic values different perspectives, backgrounds and identities.In addition to the four core principles of Sustainable development several other aspects include the dynamics of development with sustainable principles.

1. Interconnectedness

Sustainability recognizes that these four principles are interconnected. Action in one area can have positive or negative effects on the others. For example environmental degradation can harm economic and social systems and vice versa.

2. Resilience

A sustainable system is often a resilient one. It can withstand shocks and stressors, adapting to changes in the environment and society without collapsing.

3. Institution and Individual responsibility

Sustainability involves individual and institutional responsibilities. Individuals can adopt sustainability practices in their daily lives while institutions can implement environmentally and socially responsible strategies.

4. Government and Policy

Governments play a crucial role in promoting sustainability through legislation, regulation and incentives that encourage sustainable practices in governance and communities.

5. Education and Awareness

Raising awareness about sustainability and educating people about its importance are vital to driving change and creating a culture of sustainability. Promoting sustainability literacy should encourage and educate individuals about the principles and practices of sustainability to foster informed decision making. Encouraging activism should promote through active participation in efforts to promote sustainable policies and practices at local, national and global levels.

6. Personal and Lifestyle Choices

Encouraging conscious consumptions among people as the new norms and lifestyle by reducing waste and by choosing products and services with lower environmental impacts (ex: Driving electric vehicles than conventional vehicles).

Sustainability is not just an economical and environmental concern. It is a comprehensive approach to ensure a balanced and harmonious coexistence between humans and the natural world. It requires a long term perspective and a commitment to making choices that benefit both the present and future generations.

3.15 Effects of Sustainability

Development that satisfies the needs of the present without compromising the aspiration of future generations to meet their own need is deemed as Sustainability. This is generally accepted and long standing definition of 'sustainability' and 'sustainable Development' presented by the Brundland Commission in 1987. Since the publication of this report and initiation of public discourse on the subject, the concept of sustainable development has become a multi-dimensional policy target and has been posited as an action- oriented, ethical use of environment and human ecology rule for decision- maker the world over. The fundamental effects of Sustainability has been 'the triple bottom line' as the reconciliation of 'three pillars': economy, ecology and equity. Sustainability strategies rationale to sustainability principles has the essential implications for the governance of societies in the 21st century. The adoption by world leaders in September 2015 of the '2023Agenda for Sustainable Development' with it set of sustainable Development Goals indicates the current relevance of Sustainability effects in the present world.

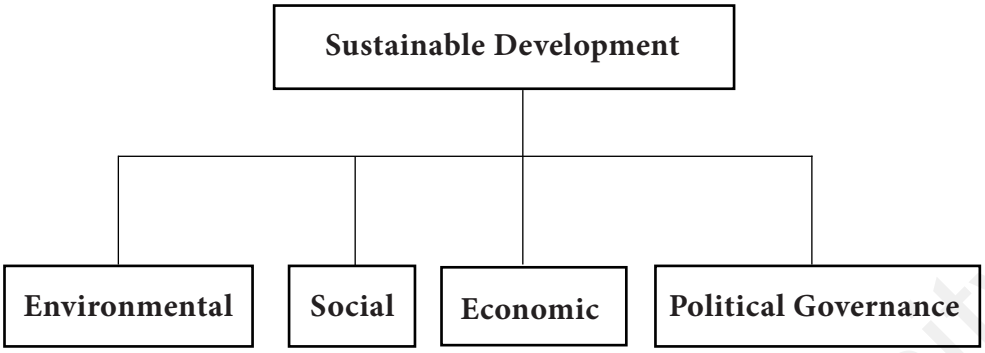
Effects of Sustainability Development in Comparison

Description	Rationalist Paradigm	Sustainability Paradigm
Philosophy	Maximization of productivity and utility for economic growth	Modulations of economic, social and ecological components of development
Functionality	Programming and control	Balancing and Networking
Focus	Policy making	Problem Handling
Goals	Reaching predefined ends	Nudging evolutionary processes
Structure	Technical/ Mechanistic	Contextual/Fluid
Strategy	Precise targeting, concentrated action, reduction of uncertainty	Changing political force fields, participatory coordination among heterogeneous actors.
Problem treatment	Cause and effect/linear models yielding solutions	Redefinition of problem for interconnected future oriented action
Implementation Mechanism	Good Governance, Firm Competitiveness	Reflexive Governance, Corporate Social responsibility

As an emerging development paradigm, sustainability offers unique understanding and change in perspective for achieving lasting economic and human progress. As compared to the rationalist political and administrative paradigm with its focus on planning and control sustainability offers an integrative and systemic approach to problem solving.

Subset of Sustainable Development

Effects of Sustainable Development are a comprehensive approach that brings together different strategies for improving the social, economic and environmental performance.



3.16 Effects (achievements) of Sustainable Development

The principle aim of the Sustainable Development is to promote a substantial growth in all the aspect of human endeavor keeping the environment resources under sensible and ethical use. By sustainable growth the OECD (Organisation for Economic Cooperation and Development) means growth that balances economic, social and environmental considerations. The OECD is one of the world's largest and most reliable sources of comparable statistical, economic and social data. It monitors trends, collects data, analyses and forecasts economic development and investigates evolving patterns of public policy area such as agriculture, development co-operation, education, employment, science and technology, industry and environment.

Sustainable development seeks to balance the economic, environmental and social dimensions of development in a long- term and global perspective. It implies a broad view of human welfare, a long term perspective about the consequences of today's activities and the full involvement of civil society to reach viable solutions. The effects of sustainable development felt across seven key thematic areas

a. Sustainable consumption and production

b. Climate change and sustainable development

c. Sustainable trade and foreign investment

d. Subsidy reform and sustainable development

e. Education for sustainable development

f. Sustainable environment and health sector

g. Governance for Sustainable Development

Key success elements of Sustainable development

Green Growth

Green Growth seen as a way to pursue economic growth and development while preventing environmental degradation, biodiversity loss and unsustainable natural resources use. Green growth policies spur transformational change and ensure that investing in the environment, can contribute to new, more sustainable sources of growth and development. The green growth strategy aims to promote economic growth and development, addressing four key environmental challenges.

a. Climate change

b. Unsustainable use of natural resources

c. Loss of biodiversity and ecosystem

d. Unsustainable materials management.

The Green Growth strategy will set out the necessary policy framework to contribute to a durable recovery while constructing more balanced growth, consistent with resilient ecosystems. The strategy will also address the political economy issues associated with the transition of greener growth, in relation to employment and distributional effects.

A. Sustainable Consumption and Production

The human's impacts on the environment can be traced back to the way humans produce and consume goods and service. From the basic of food and shelter to mobility and to luxurious such as entertainment and tourism significantly affect resource consumption and pollution. The challenge is to decouple economic development and environmental degradation by improving the efficiency of resource use and production processes.

Solutions Initiated

The importance of changing consumption and production patterns was identified as a central theme for sustainable development.

- Agenda 21, the UN programme launched in 1992 addressing sustainable development in the 21st century.
- Johannesburg Plan: The Johannesburg plan of implementation, adopted at the World Summit on Sustainable Development

in September 2002 contains country commitments to change unsustainable patterns of consumption and production, recognizing consumer habits and lifestyles must evolve.

2. Climate Change and Sustainable Development

The impact of Climate change on our environment, our economies and our society is one of the defining issues of our era. Global Climate Change threatens to disrupt the well being of society, deter economic development and alter the natural environment making it a central policy concern of the 21st century.

Solutions Initiated

- Governments around the world have reached consensus on the need to achieve large greenhouse gas emissions reductions over the coming decades and cooperate to adopt to the impacts of climate change.
- OECD 2008 Ministerial Council MeetingAt the ministerial council meeting in 2008, Finance Minister of OECD member nations underlined the need for an effective framework on climate change, stating that countries should use a mix of policy instruments in addressing climate change, including regulations and standards, taxes, carbon trading schemes, investment in new technologies and sectorial approaches.

3. Sustainable Trade and Foreign Investment

Achieving sustainable, long term economic development requires open markets for international investment as well as improved investment environments around the world. The sustainable practices support trade and investment policy goals by promoting transparent and rule based investment frameworks for sustainable economic development worldwide. Strengthening corporate and governmental responsibility for sustainable globalization through international, regional and bilateral investment and trade agreements is important.

4. Subsidy Reform and Sustainable Development

Government subsidies are among the most pervasive and powerful public policy instruments. Different types of support, including subsidies, tax breaks and other preferential treatment.

5. Education for Sustainable Development

Sustainable development and social cohesion depend on people's competencies and their understanding. Competencies include subject matter knowledge, skills, attitudes and values. In 1992, Agenda 21 underlined that 'education is critical for promoting sustainable development and improving the capacity of people to address environment and development issues'. Pursuing the priority, the role of the education system in contributing to environmental awareness and social values in the theme of UNESCO's Decade of education for Sustainable Development (2005-2014)

6. Environment and Health

Life expectancy in developing countries shortened considerably due to environmental causes. More specifically, low water quality and quantity due to poor hygiene and sanitation facilities and limited access to water supply are responsible for millions of deaths worldwide every year. To better understand the numerous costs of environmental degradation Sustainability approach has been analyzing the economic value of environmental related health care costs. Another focus area has been assessing the impacts and policy initiatives related to the presence of chemicals, including nano- materials in the environment. The role of biotechnology can also play an important role especially in Agriculture in building healthy generations.

7. Governance for Sustainable Development

Good Governance plays a crucial role in achieving the goal of sustainable development. The sustainable philosophy is taking an integrated approach to its work focusing on : innovative approaches for designing and delivering public policies; public engagement in the governance of reforms; and assessing public sector performance with a view to ensuring long term sustainability.

United Nations Sustainable development Mandate

a. 2030 Agenda

Recognizing the success of the Millennium development Goals and the need to complete the job of eradicating poverty the UN adopted the ambitious 2030 Agenda for Sustainable development which includes

1.ending poverty

2.zero hunger

3.good health and wellbeing,

4.quality education

5.gender equality

6.clean water and sanitation

7.affordable and clean energy

8.decent work and economic growth

9. Industry, innovation and infrastructure

10. Reducing inequalities

11. Sustainable cities and communities

12. Responsible consumption and production

13. Climate action

14. Life below water

15. Life on land

16. Justice and strong institutions

b. Paris Agreement

The MDGs goals were being formulated and approved, the United Nations supported the climate change negotiations which led to the Paris Agreement on climate change in 2015. The central aim of the Paris agreement is to strengthen the global response to the threat of climate change by keeping the global temperature rise below 2 degrees Celsius above pre-industrial levels or even 1.5 degrees Celsius. In order to reach these goals, financing, new technology and an enhanced capacity building framework will be put in practice.

c. 2019 Sustainable Development Summit

In September 2019, Heads of State and Government gathered at UN in New York for the Sustainable Development Summit to follow up and comprehensively review progress in the implementation of the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goal(SDGs). The event was the first UN summit on the SDGs since the adoption of the 2030 Agenda in September 2015.

d. 2019 Climate Action Summit

At the Climate Action summit in September 2019 major countries across the globe committed to cut greenhouse gas emissions to net zero by 2050.

Key entities working to support Sustainable Development and Climate Action

1. UN High level Political Forum on Sustainable Development

This unit main global forum for reviewing successes, challenges and lessons learned on achieving the 2030 agenda foe sustainable development.

2. Intergovernmental Panel on Climate Change

3. Un framework convention on Climate Change

4. The UN environment programme

5. UN- Habitat

3.17 Conclusion

The existence of future is being resting on Sustainable philosophy. The need for Sustainable approach is multi-dimensional which is sobering on three broad areas of environment, economy and social Justice. The expert panels both in academia and institutions thriving very hard to eet the issues like climate change, poverty and equity. To address and to fix these issues Sustainable approach looks more viable and applicable in this need of the hour. Development based on Sustainability will be ground for better future and for the existence of humans. United Nations and other International and national organizations with state are bringing out various policies and programme to embrace Sustainability as their mantra for development philosophies. Let us build a bright future based on Sustainability.

3.18 Let Us Sum Up

Social interactions with environment are indispensible and inanimate with the human existence. These interactions are highly influenced by social, cultural, economic and political conditions. In most of the situations the ecology and environment was sidelined and under treated with main folding the humans need and survival. This approach towards development is not sustainable and will bring adverse effects to

present and future. To combat the less sustainable and adverse practice of handling nature and ecology, humans have to adopt the principles, programmes and policies based on sustainable philosophy. Importance must be given to Sustainable development rather sheer economic and political gain. The development policies should be corroborated with healthy and sound environmental principles.

3.19 Self-Assessment

1. Define the nature and scope of Sustainable development.
2. Bring out the effects of political economy on environment.
3. Write the evolution of the concept of sustainable development.
4. Write the scope of sustainable development.
5. Elaborate the major debates on sustainable development.
6. Write the sustainable guiding principles.
7. Define global change and factors responsible for climate change.
8. Compare the rationale paradigm with sustainable approach.
9. Summarize the effects of Sustainable Development.
10. List out the entities working to support sustainable development.

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UNIT - IV

Lesson 4.1 - Environmental Ethics in India

Structure

4.1 Learning Objectives

The main objectives of this unit are

1. To provide a discourse on the anthropocentric and non-anthropocentric views of environmental ethicist
2. To summarize the evolution of environmental ethics in India historically
3. To understand the religious environmentalism of Indians
4. To comprehend the environmental policy and legislations in India
5. To discuss the functions of enforcement agencies in implementing Environmental legislations in India

Key words

Environmental Ethics, Anthropocentricism, Ecocentrism, Theory of Interdependence, *Ahimsa, Dhrama,* Tamils Eco- Poetics, Forest Act, Stockholm Declaration, National Forest Policy

4.2 Introduction

'Environmental Ethics' is used as an umbrella term to cover all kinds of moral debate concerning human attitudes toward the nonhuman natural world. The phrase 'environmental ethics' consists of two words- 'environmental' and 'ethics'. The environment means 'the natural world in which people, animal and plants live. The word ethics means, the moral principles that control or influence a person's behavior and the branch of philosophy that deals with moral principles. Environmental ethics deals with ethical aspects of environmental problems. Environmental problems include pollution, depletion of natural resources, loss of wilderness, extinction of species and many other factors which bring about ecological imbalances causing in turn problems for human and non-human survival. Environmental ethics is a branch of philosophy that explores the moral and ethical dimensions of our relationship with the natural world and the environment. It is concerned with question about how humans should interact with the environment. Human's moral obligations towards nature and how we should address environmental issues and challenges were the core contexts of Environmental ethics.

4.3 Environmental Ethics

The environmental ethicists are divided into two sects- anthropocentric and nonanthropocentric.

(a)Anthropocentricism is a view which puts human beings at the center of the Universe. Humans can manipulate environment for the sake of their own benefits and interests. Human beings have the moral right to use non-human nature merely as a means. Nature has only instrumental value; value as a mean to a human end.

(b) Non- Anthropocentricism is asset of ethicist who believes both human beings and non- human beings have intrinsic value. Thus, killing an animal or cutting a tree is not always morally justifiable unless it becomes necessary for maintaining the food-chain. Humans therefore have no moral right to engage in vandalism by using non-human nature merely as a means to fulfil their self-centred and selfish goals. Human's dutyand

responsibility of preserving nature is for the sake of nature itself and not merely for their own sake.

4.4 Key Attitudes Towards Environmental Ethics

The way we handle environment reveals much more about beliefs regarding humans and the world around us. Some people see human beings as merely one among many species, others view human beings' role as caretaker or stewards of nature.

i. Anthropocentricism

According to anthropocentric attitude, protection or promotion of human interests or wellbeing at the expenses of non-human things turns to be nearly always justified. Aristotle maintains that 'nature has made all things specifically for the sake of man' and the value of non-human things in nature is merely instrumental.

ii. Stewardship

Many tribal or indigenous people in traditional societies have a strong sense of stewardship or responsibility for nature. As a custodian of resources, they see their proper role as working together with human and non-human forces to sustain life. Stewardship requires a person to consider the entire universe as her or his extended family and all living beings are members of the household. As stewardship of our environment humans are obligated to use the power of science and technology to improve rather than destroy or degrade the world.

iii. Ecofeminism

Many feminists argue that anthropocentricism, or stewardship is sufficient to solve environmental problems. They argue that all these attitudes have come out of a patriarchal system based on domination and duality. It claims that men are superior to women, minds are better than bodies, the culture is better than nature. Feminists see an important connection between patriarchal domination, exploitation and illtreatment of women, children, minorities and nature.

Ecofeminism is radical attitude against patriarchy. It is rooted in women's biological. procreative and maternal role. Ecofeminism finds instant rapport with eastern concepts of 'mother nature'. The ecology of nature is linked to the biology of women's bodies, and the exploitation of

nature to the exploitation of women's womb. Ecofeminism envisions an attitude of subsistence life style, in harmony with nature and pervaded by 'feminist principle'.

Ecofeminism is a pluralistic, non-hierarchical, relationship oriented philosophy recommends that humans could reconsider their relationship to nature in nondominating ways and this is proposed as an alternative to patriarchal systems of dominations.

iv. Biocentrism and Ecocentrism

The Biocentric attitude putting that all living organisms have values and rights, regardless of whether they are useful or not. Aldo Leopold in his famous essay on the Land Ethic included the whole biotic community as part of the land. Leopold pointed that the history of civilization has been accompanied by a gradual extension of inherent values and rights, first to men, then to women, children and minorities and more recently to non-humans. Leopold argues that values should be extended to the recognition of inherent worth to another organism as well.

4.5 Principles of Environmental Ethics

1. Respecting the intrinsic value of nature: Natural resources should not be treated as a commodity or to exploited and discarded.
2. Interdependence of species and ecosystems: Humans depend on nature and natural systems. Humans must recognize their role in preserving and protecting the environment.
3. Ecological Sustainability: Humans should realize there need only cannot be emphasized while consumption and using of the natural resources. Environmental ethics endorses the concept of sustainability which calls for using natural resources in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs.
4. Human equity: Humans must strive for a just world where the rights and needs of human, animals and plants are respected and protected.
5. Deep Ecology: Deep ecologists argue for a radical shift in human consciousness emphasizing a re-evaluation of human need and consumption patterns to promote the well-being of the entire biosphere, not just human interests.

6. Environmental Justice: Environmental ethics is concerned with the issues of environmental justice which addresses the unequal distribution of environmental benefits and burdens particularly among developing nations and marginalized communities. It advocates equitable access to clean and healthy environment for all.
7. Right to Participate: Citizens should have the right to participate in environmental decision making.

4.6 Environmental Ethics in India

The ethic of nature understood as a set of abiding concerns and guiding principles that human articulate and deploy in their interactions with the non-human world. Environmental thought in India as it emerged in the aftermath of the establishment of India as a secular, socialist republic always had a troubled relationship with religious environmentalism. Religiously imbued Indian society valued and protected the nature through ideas of faith.

Religious Environmentalism

The Indian spiritual tradition combines perspectives on nature and environmental ethics form Jainism, Buddhism and Hinduism. In this case nature was seen with compassion and empathy; in to certain extent nature was seen and worshipped as God and Goddess.

Buddhism

The core principles of Buddhism religion are compassion, respect, tolerance and ahimsa (non-injury) towards all human beings and all other creatures that share this planet. Buddha also set down rules forbidding the pollution of rivers, pond and wells. As Buddha says in Sutta-Nipata

"Know ye the grasses and the trees…. then know ye the worms, and the different sorts of ants…. Know ye also the four-footed animals small and great… the serpents… the fish which range in the water…. The birds that are borne along on wings and move through the air…

Buddhist regards the survival of all species as an undeniable right, because as coinhabitants of this planet, they have the same rights as humans. In Buddhism the rivers, forests, grass, mountains are highly respected and regarded as bliss best owners. Buddhist thinkers have always had great respect for the Sun, moon and other planets.

The teaching of Buddhism has concentrated on the theory of Karma (theory of cause and effect). They demonstrate that unmindful neglect of the principle of right living may lead to chaos and thus to environmental crises. No exploitation of nature beyond what is needed for survival and if we believe that all life forms are interconnected, our exploitative tendencies towards nature can be controlled. **"All Life is Interconnected'**and should be cared for is the foundation of the Buddhist ethics of nature.

Buddhist Theory of Interdependence

The basic teaching of interdependence in Buddhism stands to means that "nothing stands alone apart from the matrix of all else". Nothing is independent and everything is interdependent with everything else. Buddhist ecological ethics follows a tendency common in religious or moral discussions-a predisposition to regard individual greed and excessive consumption as a moral failing.

Environmental Ethics in Jainism

Jainism is embedded with mutual sensitivity towards all animate and inanimate beings and envisages interconnectedness of life forms. It describes that human I not a privileged species but a constituent of the cosmos consisting of millions of lives.

Integration of Animate and Inanimate Being

Jain cosmology integrates each and every animate and inanimate being into a single spectrum. Such interconnectedness visualizes the idea of harmony and enduring relationship of humans with other elements of nature. If such ecological interconnectedness could be adopted in real practice it will be help to form a sustainable environmental policy. Jain attitude towards nature give righteous view of coherence and co-existence.

Jain Karma theory

Jain Karma theory provides scope to form environmental ethics conducive to modern age. It gives scope not to indulge but to make adjustment with nature. Jain environmental ethics do not believe that everything including plants and animals have been created advantage of human beings. Though human beings live in a particular economic and cultural tradition but sympathetic attitude towards nature is necessary.

Ahimsa as Environmentalism

Ahimsa is pragmatic response to environmentalism. Ahimsa the non-violent approach towards animal kingdom can deliver mutual respect between humans and other animals. The compassion for animals has been shown by strict vegetarianism. Jain lay followers are told to avoid violent actions even at minute level. They cannot adopt occupations like production and sale of charcoal, cutting and sale of timber, construction and sale of carts, use of animals in transportation of goods, use of animal byproducts like ivory, bones, conch shells, trade in lacs and similar products, agriculture. Jainism is more emphatic and pragmatic in reverence of plants and animals. Mahavira says that trees have many good qualities and plants have life like humans and animals. Trees are born, grown and mature like human beings. They feel pain when cut down. They require nourishment. Their destruction and consumption lead to misfortune. The *Acaranga Sutra* mentions vows to refrain from actions that lead to injuring the plants. The trees should be protected not destroyed.

Ahimsa leads to liberation from karmic bondage and its perception of *Jiva* is highly ecological because it regards all form of life as a member of single community (both animate and inanimate). *Ahimsa* (non-violence) is the fundamental tenet of the Jain way of life, a term that is clearly allied with realism, common sense and personal; worth and responsibility. It touches the deepest and noblest aspects of human nature: *'it adheres to the universal law which states that like, order comes of order, and peace can only be achieved through peace'*. Jainism emphasizes that in all situations the ends and means are one and the same and that truth, honesty and compassion must be the foundation of any truly civilized community.

Environmentalism Ethics in Hinduism

A good environmental sense has been one of the fundamental features of ancient Hindu philosophy. The civilization of India has grown up in close association with nature. There has always been a compassionate concern for every form of life in the Indian mind. According to Hindu scriptures people must not demand or take dominion over other creatures. They are forbidden to exploit nature; instead, they are advised to seek peace and live in harmony with nature. The Hinduism demands veneration, respect and obedience to maintain and protect the harmonious unity of God and nature.

Aranyani Goddess of Forest

Environmental awareness was realized even in the pre-vedic period. There are references to 'Tree Worship' in Mohenjo-Daro in Indus valley civilizations. The environmental awareness was continued in Vedic period. The concept *Aranyani* the queen of forests identical to the concept of tree Goddesses of Indus people. Aranyani are worshipped as the presiding spirit of forests, conceived as women in praised, honoured by herbs and described as mother of wild animals.

Trees, Rivers and Animal forms as Gods

Animals and nature were revered along with gods in Hinduism. Hanuman and Ganapathi are the most powerful deities. Peepal, Ganga, Himavan, Tulsi , Banyan Trees are worshipped as divinely symbols and are considered holy even today. *Charaka Samhita* book on Ayurvedic medicines deals with divine herbs, with deep insight into preservation of environmental balance to benefit personal health and pollution free environment. *Durga Shaptasati* prescribes so long as mother earth is full of trees and forest with hills, she would continue to nurse and rear the human race.

Doctrine of Hindu Dhrama

There has always been a compassionate concern for every form of life in the Indian mind. This concern is projected through the doctrine of *Dharma*. The Hindu rishis of the *Vedic* era perceived the value of maintain a harmonious relationship between the needs of man and spectacular diversity of the Universe. To them, nature was not only the mother that sustained their life; it was the abode of divinity. Sanctity of life to them included not only efforts to seek salvation, but to seek it by developing a scared attitude towards nature.

Vasudhaiva Kutumbakam (One Earth One Family One Future)

The theme of India'sG20 Presidency- Vauudhaiva Kutumbakam or On Earth, One Family, One Future is taken form the ancient text Maha Upanishad. The theme affirms the value of all life- human, animal, plant and microorganism- and their interconnectedness on the planet earth and in the wider universe. The theme spotlight LiFE Lifestyle for Environment with its associated, environmentally sustainable and responsible choices both at the level of individual lifestyle as well as national development,

leading to globally transformative actions resulting in a cleaner, greener and bluer future. This Hindu prospect towards environmental ethics reaffirms the importance of justice, prudence, humility and reverence for life and nature. The affirmation of the 'intrinsic worth' and something like rights of each individual person and all animal and plant species and in some ways nature and ecosystems carries the correlate or recognizing man and nature. Thus the most radical approaches adopt a holistic analysis of the human- nature relationship and tend to develop a non- anthropocentric and ecocentric ethic that draws our attention to the importance of developing a higher ecological consciousness which encourages us to adopt holistic attitude towards nature.

4.7 Environmental Aesthetics of Tamil Culture

Environmental aesthetics attempts to conceptualise the aesthetic concerns for the environment as it is worked out in the aesthetic process, through its various stages right from the initial creative ideology, formulation, composition. The Sangam age is unique in South Indian history and Culture for its unparalleled creative contribution and its poetics offers much material to comprehend the social, cultural and Environmental orientation of ancient Tamils. The major themes of Sangam poetry are love and war, and that accounts for the two broad divisions of the literature as a whole: akam and puram love-poetry and war-poetry respectively. Akam appears to monopolize the major portion of Sangam Literature. The life of couples of lovers is given its setting in time and place. Readers trace out the life of lovers running through the whole gamut of experiences so provided by the system.

Tamils Eco- Poetics

Aintinai concepts

Aintinai or the fivefold categorisation of the environment into *Kurinci, Mullai, Marutam, Neidal and Palai,* combined with the corresponding flora and fauna by the Sangam poets towards the formulation of an environmental aesthetics. A.K. Ramanujan doyen of Indian Literary figure puts in like this about *Aintinai* "the actual objective landscapes of Tamil country become the interior landscapes of Tamil poetry".

Aintinai (Spatial Identity)

1. Kurinji tinai: the mountain tract and the where the valley begins.

2. Mullai tinai: the environment is the jungle and rocky land bordering.

3. Marutam tinai: the land lies cultivated and fertile.

4. Neital tinai: the coastal and seashore

5. Palai tinai: the desert land

The *Akam* poems abound in sensual descriptions of nature and poet's eye move between the inner and outer nature. In these poems over two hundred plants of all the five Tamil regions are named, described sued in insets and comparisons. Root, stem, bark, bud, petal, inflorescence, seasons, and special kinds of pollination are observed and alluded to. And their properties are aptly used to evoke human relationship.

Sangam custom to be true to nature- the inner and the outer and the environmental factor was a determinant in the poetic process. The real world was always kept in sight and included in the symbolic. The aesthetic for the ancient Tamils was a significant system that was strictly conventional yet open-ended. *They looked upon the entire environment as one unified whole, where meaning was not something that was realized at the end but a process interlinked to all and everything at all points.* This comes quite close to what we now recognise as a biosphere in ecological terms.

Tinai roots in Behavioral pattern

The five sorts of landscape of *aintinai* are associated with "behaviour pattern" in such a way that they from the characteristic environments in which these "behaviour patterns" are realized. The "behavioural pattern" and the type of landscape associated with it from a unit of meaning, so the landscape can symbolically stand for the corresponding "behavior pattern" and vice versa. For example, *kurinji* is one of the five allegorical landscapes (*Tinai*) into which Tamil poetry divide the land. Literary critics describes *tinai* as " a unity of behavior patterns and the appropriate landscape". Each of the landscapes given above are assigned "first elements" as "space" (*nilam*) and "time" (*polutu*), "native elements" (*Karu*) and "human elements" (*uri*). It should be realized that each of the states of love shows pictures and symbols corresponding with a particular landscape.

Tirukkural and Cultural Ecology

Tirukkural is one of the important and celebrated of the *Patirenkirkkanakku* (Eighteen Ethical Works) in Tamil Literature. This work commends to the reader a feeling of compassion for all individuals and world, regardless

of any differences. *Tirukkural* reflects the social and cultural pursuits of that time. *Tirukkural* also deals with the issues of nature and it proposes the ideal relationship between man and nature. *Tirukkural* says that whole world depends on water. All the activities in the world cannot be possible if the rain fails. All the activities of living creatures including humans depend on water.

Neerindru Amaiyaadhu Ulakenin Yaaryaarkkum

Vannindru Amaiyaadhu Ozhukku

When water fails, functions of nature cease you say;

Thus, when rains fail, no men can walk in 'duty's' ordered way.

If it be said that the duties of life cannot be discharged by any person without water, so without rain there cannot be the flowing of water.

Thus, the ancient Tamil Culture has compounded the importance and intrinsic quality of nature with Human. The embodiment of nature and its influence the social and cultural life of Tamils were vividly described in their poems with eco poeticism. The manifestation of human destiny is associated with the nature and substantiated the existence of all species as the birth right.

Ramalinga Swamigal (1823-1874)

Ramalinga Swamigal Vallalar, commonly known in India and around the world as Vallalar, advocated a casteless society and staunch believer of compassionate to all living beings. He forbade killing animals for the sake of food and condemned inequality based on birth.

His poem 3471 form *Tiru vartupa*, talks his attitude towards environment. He figures out the love towards nature and other species of the earth. Known for compassion towards human beings, he too celebrated for the higher order love and empathy toward nature and environment. The poem goes like this

When I saw the withered crops without water, when I went from house to house, my mane thinned by hunger, and when I saw the poor man who was not satisfied with his hunger, and when I saw the people who were suffering standing in front of me like a chain of sorrows, I felt sorry. I was emaciated by the sight of emaciated and emaciated people who were suffering from incomparable dignity and poverty.

` His love and compassion to both humans and inanimate things speaks about the value and ethic of Tamils towards nature and environment. The environmental ethics in India is loosely embedded in the religious, social and cultural system of ancient Indian. Revelation on Nature and its importance was felt and clearly transformed as life style of ancient Indians and Tamils. Their environmental concepts are highly relevant in this present fractured ecology and environment. The sustainability life was the central theme of ancient Indians with embracing the nature and environment.

4.8 Environmental Legislations in India

Environmental Policy and Legislation in India

Policies lay down the general objectives and action plans for administration. Policy formulation becomes indispensable, by being an instrument of transformation. Though the dynamic Environmental policy precise identification of environmental problems can be fixed, and forming priorities and alternative approaches can be built. Policies articulate the choice in terms of goals expressed, provide organizational, personal support and resources to ensure effective implementation of environmental programmes. In India attention has been paid right from the ancient times in the field of environmental protection.

Environmental Policy and Laws in Ancient India

The conservation of environment formed an ardent article of faith, reflected in the daily lives of the people and enshrined in myth folklore, art, culture and religion. In Hindu theology forests, trees and wildlife protection held a place of special reverence. Cutting certain trees was prohibited and punishment was prescribed for such acts. Hindu culture moral injunctions acted as guidelines towards environmental preservation and conservation. To maintain the quality of water and to avoid the water pollution, *Manusmiriti* advised not to contaminate water by urine, stool or coughing, un-pious objects, blood and poison. *Yagayavalkya Smriti* and *Charka Samhita* give many instructions for the use of water for maintaining its purity. Under the *Arthasastra* various punishments were prescribed for cutting trees, damaging forests, regulation of forest produce and protection of wildlife. *Arthasastra* also prescribed punishment for causing pollution and un-civic sanitation.

Environmental Policy in Medieval India

During the Medieval India less importance was shown towards environmental management and did not receive much attention. To Medieval rulers, forest meant no more than woodlands where they could hunt. Barring 'royal tree' which enjoyed patronage from being cut except upon a fee, there was no restriction on cutting of other trees. So, forest coverage during this period shrank steadily in size. The forests were managed with the help of a rules and regulations with the assistance of local communities. The religious policy of Akbar based on the principal of complete tolerance also reflects concern for protection of birds and beasts and endeavours were taken to stop unnecessary killings of species.

Environmental Policies and Laws in British India

The establishment of colonial rule, many changes were brought in the religiously oriented indigenous system. The British regime saw the beginning of organized forest management.it was the forestry, wildlife and water pollution attracted the administrator's attention. In the field of forest protection, the enactment of the **Forest Act (1865)** was the first step at affirmative to state monopoly right over the forests. In the field of wildlife protection, the British practiced selective wildlife conservation. The protection and management of water resources in India came through the first major development in the form of **Bengal Regulation VI of 1819.**

This act paved the way for the government with sovereignty over water resources. **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 the sea by oil. In 1860 an attempt was made to control especially water and atmospheric pollution through criminal sanctions under the Indian Penal Code. The **Bengal Smoke Nuisance Act of 1905** and Bombay Smoke Nuisance Act of 1912 were the earlier laws enacted during the British Governance aimed at controlling air pollution. The environmental policy during the British rule was not directed at the conservation of nature but rather was directed at the exploitation of common resources with the primary objective of earning revenue. Majority of these acts had a narrow scope and limited territorial reach.

4.9 Environmental Policy and Laws after Independence

Indian Constitution

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). Even after the five decade of independence the set of laws passed in the erstwhile British India is still in operation without any significant charge.

The Post- Independence Development

Until 1970, there was no significant legislative activity in the field of environmental protection. Very few acts are exceptional to this condition. **The Factories Act of 1948** required all factories to make effective arrangements for waste disposal and empowered State Government to frame rules implementing in this directive. The **River Boards Act of 1956** was passed to institute the river boards, empowered to prevent water pollution of inter-state rivers. To prevent cruelty to animals, **the Prevention of Cruelty of Animals Act** was framed in 1960. Some states also took initiative in the field of environmental protection, viz., **Orissa River Pollution Prevention Act, 1953 and Maharashtra Prevention of Water Pollution act 1969.** These scattered provisions for checking pollution of air, water but there was no unified effort in developing any policy concerning the pollution emanating from these areas.

Stockholm Declaration 1972 and Aftermath

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 active through five years plans as well as the legislations enacted subsequently to curb and control environmental pollution. After 1972 Stockholm influence, comprehensive and special environmental policies and laws were enacted by the Central and States Government.

Important Environmental Acts Passed After 1970s

1. The Wildlife (Protection) Act, 1972 aimed at rational and Modern wild life management.
2. The Water (Prevention and Control of Pollution) Act, 1974, provides for the establishment of pollution control boards at centre and states.

3. The Forest (Conservation) Act, 1980aimed to check deforestation, diversion of forest land for non- forestry purposes and to promote social forestry.
4. The Air (Prevention and Control of Pollution) Act, 1981 aimed at checking air pollution control boards.
5. The Environmental (protection) Act, 1986 is a landmark legislation which provides for single focus in the country for protection of environment. It provides mainly for pollution control with stringent penalties for violation.
6. The National Environmental 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 is set up in Delhi, Calcutta, Madras and Bombay.
7. The national Environment Appellate Authority Act, 1997, established 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 subject to certain safeguards under the Environment (protection) Act, 1986.
8. The Biological Diversity Act, 2002, a legislation effected in the involvement of local communities in the protection of biodiversity around them.

4.10 Environmental Policy Since 1970s

In 1970s it had been realized that unless a national body was established to bring greater coherence and coordination in environmental policies and to integrate environmental concerns in the plans for economic development, a National Committee on Environmental Planning and Coordination (NCEPC) was established in 1972 under Department of Science and Technology.

Objectives of NCEPC

- Apex advisory body in all matters relating to environmental protection and improvement.
- To plan and coordinate the polices matters pertaining to Environmental issues

- To coordinate with various ministries and governmental agencies in execution of Environmental policies.

Five-Year Plans and Environmental Policy'

The fifth-year plan (1974- 1979)

This five-year plan stressed that the NCRPC should be involved in all major industrial designs and a link between development planning and environmental management has to be maintained.

- MNDs (Minimum Needs Programme), covering rural, education, health, nutrition, drinking, water received a fairly high priority and was expected to minimize environmental pollution and degradation in rural areas.

The Sixth Five Year Plan (1980- 1985)

- In the Sixth Five Year plan, an entire chapter on 'Environment and Development' emphasized sound environmental and ecological principles in land use, agriculture, forestry, mineral extraction, energy production.
- It provided environmental guidelines to be used by administrators, while formulating and implementing programmes, and lay down an institutional structure for environmental management by the central and state governments.

The Seventh Five Year Plan (1985-1990)

- The basic approach taken by seventh plan was to emphasize sustainable development in harmony with the environment, as the federal government and the Union government had recognized the negative effects that development programmes were having on the environment.
- The Seventh plan recognized that 'the nation's planning for economic growth and social well-bring in each sector must also work to secure improvement in environmental quality'.

The Eight Five Year Plan (1992-1997)

- The plan period initiated the systematic effort to integrate environmental considerations in the planning process in all key socio- economic sectors.

- As a result sustained planning in all major sectors like industry, science and technology , agriculture, energy and education include environmental considerations.

The Ninth Five Year Plan (1997-2002)

- The plan period has emphasized "Growth with Social Justice and Equity".
- The Joint Forest management and Community Forestry have been specially emphasized.

National Conservation Strategy and Policy Statement on Environment and Development

In 1992, the Union Government adopted "National Conservation Strategy and Policy Statement on Environment and Development". NCS adopts the policy of 'Sustainable development' and declares the government intentions to orient policies and action in unison with the environmental perspectives. The NCS shortlisted the dimensions of the environmental problems facing India and declares strategies for action in various fields such as agriculture, forestry, industrial development, mining and Tourism. Special emphasizes were given to the relationship between women and the environment.

Policy Statement for Abatement of Pollution

In 1992, the Union Government came out with 'Policy Statement for Abatement of Pollution'. This statement declares the objective of the government to integrate environmental considerations into decision making at all levels. This policy statement adopts fundamental guiding principles

(i) Prevention of Pollution at Source

(ii) Adoption of the best available Technology

(iii) Public participation in decision making

National Forest Policy (1980)

By a resolution dated 12th May 1952, the Government of India under erstwhile Ministry of Food and Agriculture enunciated a forest policy to be followed in the management of State Forests in India. However, the forests in the country have suffered serious depletion. The seriousness of new forest policy felt to fix the remedies to the following issues.

- Arising pressure for increase demand for fuel food, fodder and timber
- Inadequacy of protection measures
- Diversion of Forest lands to non-forest uses without ensuring compensatory afforestation and essential environmental safeguards.
- Tendency to look upon forest as revenue earning resource.

The need to review the situation for the future, a new strategy of forest conservation has become imperative.

Basic Objectives of National Forest Policy-1988

- Maintenance of environmental stability through preservation and where necessary, restoration of the ecological balance that has been adversely distributed by serious depletion of the forests of the country.
- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of Flora and Fauna, which represent the remarkable biological diversity and genetic resources of the country.
- Checking soil erosion and denudation in the catchment areas of rivers, lakes, reservoirs in the "interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs.
- Checking the extension of sand-dunes in the forest areas of Rajasthan and along the coastal tracts.
- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programme especially on all denuded, degraded and unproductive lands.
- Meeting the requirements of fuel-wood, fodder, minor forest produce and small timber of the rural and tribal populations.
- Increasing the productivity of forests to meet essential national needs.
- Encouraging efficient utilization of forest produce and maximizing substitution of wood.
- Creating a massive people's movement with the involvement of women, for achieving these objectives and to minimize pressure on existing forests.

General Legislations on Environment

In India, 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. Some of them are 'general' having an "indirect" bearing on environment protection while others are special.

(i) Water Act

(ii) Air Act

(iii) Environmental Act

(iv) Forest Act

These acts are being 'directly concerned with environment protection.

General Legislation covering Environmental Issues

(i) Indian Penal Code (1860)

(ii) Code of Criminal Procedure (1973)

(iii) Code of Civil Procedure (1908)

The law of public nuisance contained in Sec.133, Cr.P.C has been used in number of cases for the purpose of protection of the environment. The general legislation like IPC, Cr.PC, CPC, MV Act and Labour act could be quite effective in controlling environmental violations because of the availability of the enforcement machinery. Some of these acts have been amended recently to incorporate current trends and requirements.

Specific and sectorial legislations having a bearing on the environmental aspects

(i) The Factories Act (1948)

(ii) The Mines Act (1952)

(iii) The Industries (development and regulation) act (1951)

(iv) The Insecticides Act (1968)

(v) The Atomic Energy Act (1962)

(vi) The Motor Vehicles Act (1939) & (1988)

(vii) Various states Municipal Acts

In 1987, shortly after the Bhopal Gas Tragedy and the Supreme Court ruling in the *Shriram Gas Leak case*, amendment to the Factories Act was introduced, special provisions on hazardous industrial activities.

The amendment empowers the state to appoint 'site appraisal committee' to advice on the initial location of factories using hazardous processes.

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 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 percent of the pollution load in India was taken care of by the Motor Vehicles Act 1939. The act empowered the state government to make rule inter-alia regarding the emission of smoke, visible vapour, sparks, ashes, girt or oil. The 1939 act was repealed by the Motor Vehicles Act 1988. Section 110 of this new act empowers the central government to make rules regulating the construction equipment and maintenance of motor vehicles and trailers.

In 1989 the Central Motor Vehicles Rules introduced nationwide emission levels for both petrol and diesel engine. These rules were further amended in 1992. The amendments lays down standards regarding emission levels of carbon monoxide, nitrogen oxides and un burnt hydrocarbons for petrol and diesel vehicles. The vehicles manufactured after April 1, 1992 must meet the additional emission standards prescribed for petrol and diesel vehicles. As a part of control mechanism, the amended rules authorized the regional or State Transport authorities to allow private agencies such as petrol stations to test the emission level of vehicles and issue "pollution under control' certificates. Under rule 116, the registration of vehicle found to be exceeding the permissible emission levels can be suspended.

4.11 Exclusive Environmental Acts in India

The Environment Protection Act, 1986

Though there is a host of legislation in India aimed at protecting the environment from pollution and maintaining the ecological balance, the environment, the environment has not so far been considered in its totality. The Environment (protection) Act, 1986, enacted under Article 253 of the constitution of India to implement the decisions made at the United Nations Conference on Human Environment held at Stockholm, 1972 was expected to fill a blue print for a progressive policy for protecting the ecosystem. The act seeks to supplement the existing laws on control of

pollution by enacting a general legislation for environmental protection and to fill the gaps in regulations of major environmental hazard.

Objectives of the Environment Protection Act

1. To implement the significant decisions taken, relating to environment safety and protection, at the United Nations Conference on the Human Environment held in Stockholm in June 1972.
2. To relate different aspects of the environment and need for comprehensive legislation that filled the gap in the existing laws.
3. To create new authorities for the purpose of protecting and improving the environment and also to coordinate the activities of already existing authorities constituted under pervious laws.
4. To provide for stringent and deterrent punishment to the offenders of the natural environment who endanger its safety and health.
5. To facilitate the growth of subordinate and delegated legislation on ecologically sensitive topics and environment protection.
6. To promote sustainable development, balance the overall development with environmental protection.

Substances of the Environment Act

The Environment Protection Act is an umbrella legislation enacted to provide for the central Government coordination over the Union and State authorities established inter-alia under the Water Act (1974) and the Air Act (1981)

According to the preamble of the Environment Act, the objective of the Environment Act is "*…… to provide for the protection and improvement of environment and for matters connected therewith*". The act is a special law and extends to the whole of India.

The act defined the cause of environmental pollutant includes solid, liquid and gaseous substances. The act considers pollution to be something like adulteration. It is universally accepted that any environmental modification which has undesirable short terms of long-term effect on the welfare of the environment in environmental pollution.

Important Provisions of Act

Section 2 of Environment Protection Act

Sections 2 of the act various terms used in its provisions. These definitions are as follows:

1. Environment: Environment has been defined to include air, water and land, and the inter-relationship among between air, water, land and human beings, other living creatures, microorganisms, plants and property.
2. Environment Pollutant: A pollutant is any substance in a solid, liquid, or gaseous state, which when present in a certain concentration can be injurious to the environment.
3. Environment Pollution: The presence of an environmental pollutant in the environment is called environment pollution.
4. Hazardous Substance: It refers to any substance or preparation which can cause harm to humans, plants, other living creatures, property or the environment due to its chemical or physicochemical properties or handling.

Section 3- Powers of the Central Government to take measures to protect and improve the environment

Section 3 empowers the Central Government to take all such measure as it deems necessary or expedient to protect and improve the quality of the environment and to prevent, control and abate environmental pollution.

1. To coordinate actions among state government, officers and other authorities.
2. To plan and execute nationwide prgramme.
3. To lay down standard for the quality of different aspects of the environment.
4. To lay down the standards for emission or discharge of pollutants.
5. To restrict the operation of ceratin industries, processes or operation in specific areas.
6. To lay down procedure and safeguards for the prevention of pollutioncausing accidents and take remedial measures.
7. To lay down procedure and safeguards for the handling of hazardous substances.
8. To examine the manufacturing processes, materials, and substances those are capable of causing pollution.
9. To carry out and sponsor investigations and research on the issues related to pollution.
10. To inspect the premise, plant, equipment, machinery, manufacturing or other processes, materials or substances.

11. To establish and recognise environmental laboratories and institutes.
12. To prepare codes, manuals, or guides related to the prevention, control and abatement of environmental pollution.

The central government is also authorized to institute authorities for the purpose of exercising such powers and functions as the governments may delegate to it.

Section 4, 5 &6 – Power to lay down rules to regulate Environmental Pollution

The central government has also been authorized to frame rules on the matters mentioned below.

1. The standards of quality of air, water or soil.
2. The maximum allowable limits of environmental pollutants
3. The procedures and safeguards for the handling of hazardous substances.
4. The prohibition and restrictions on the handling of hazardous substances.
5. The procedures and safeguards for the prevention of accidents likely to cause pollution and provide for remedial measures for such accidents.

Water Acts

The green revolution and rapid industrialization and Urbanization have resulted in a profound deterioration of India's water quality. To provide legislative support for prevention of water pollution, Parliament passed India's first major Water Legislation named as Water (protection and Control of Pollution) Act, 1974. Some legislative provision for water pollution is also included in the Environment (protection) Act, 1986. Some provisions of this act were amendment in 1988.

Important Provision of Water (Prevention and Control of Pollution) Act -1974

The main objective of this act is to provide for the prevention and control of water pollution and maintaining or resorting of water (in the stream of well or on land). Important provisions of this act are given below

- The act vests regulatory authority in the state boards empowers these boards to establish and enforce effluent standards for factories discharging pollutants into bodies of water. A central board performs the same function for Union territories and coordinates activities among the states.

- The boards control sewage and industrial effluent discharges by approving, rejecting or conditioning applications for consent to discharge.
- The board to ensure compliance with the act by including the power of entry for examination, testing of equipment and other purposes and power to take the sample for the purpose of analysis of water from any stream or well or sample of any sewage or trade effluents.
- The Board can close a defaulting industrial plant or withdraw its supply of power or water by an administrative order.

The Water (Prevention and Control of Pollution) Cess Act of 1977

The water Cess Act was passed to help meet the expenses of the Central and State Water Boards. The act creates economic incentives for pollution control and requires local authorities and certain designated industries to pay a cess (tax) for water consumption. This revenue is used to implement the Water Act. The Central Government after deducting the expenses of collection pays the Central Board and states such sums as it deems necessary to enforce the provisions of Water Act. To encourage capital investment in pollution control, the act gives a polluter a 70 percent rebate of the applicable Cess upon installing effluent treatment equipment.

Air Acts in India

To provide legislative support for prevention and control of air pollution, the Government of India enacted a central legislation named as the Air (prevention and Control of Pollution) Act, 198. The act aims to prevention, control and reduction of air pollution. Besides this, Environmental (protection) act, 1986 also covers some aspects of air pollution. This act was amended in the year 1987 for better coverage and reaches the cause of air pollutants.

Important Provisions of Air act -1981

- To implant the decision taken at the United Nations Conference on the Human Environment held at Stockholm in June 1972, Parliament enacted the nationwide Air act.
- The main objective of this act is to improve the quality of air and to prevent, control and abate air pollution in the country.
- To enable an integrated approach to environmental problem, the Air Act expanded the authority of the central and state boards established under the water act to include air pollution control.

- Under the Act, all industries operating within designated air pollution control areas must obtain 'consent' (permit) from the State Boards.
- The states are required to prescribe emission standards for industry and automobiles after consulting the Central Board and nothing its ambient air quality standards.
- Act granted power to the board to ensure compliance with the Act includes the power of entry for examination, testing of equipment and other purpose and power to take the sample for the purpose of analysis of air or emission from chimney, fly ash or dust or any other outlet.
- Act strengthened the enforcement machinery and introduced stiffer penalties. Now the board may closedown defaulting industrial plant its supply of electricity or water.
- Act introduced a citizen's suit provision into the air act and extended the act to include noise pollution.
- Air act grants discretion to each state Government to designate particular areas as "air pollution control areas" within which the provision relating to regulations of pollutants discharge through permit system.

The Forest (Conservation) Act of 1980

First Forest act in India was enacted in 1927. It was enacted to consolidate the law related to forest, the transit of forest produces and the duty leviable on timber and other forest produce. Subsequent this Act, the Forest (Conservation) Act was promulgated in 1980 to make certain reforms over the preceding Act of 1927. The 1927 acts deal with the four categories of the forest, namely reserved forests, village forests, protected forest and private forests. Any unauthorized felling of trees quarrying, grazing and hunting in reserved forest is punishable with a fine or imprisonment. Alarmed at India's rapid deforestation and resulting environmental degradation, Central Government enacted the Forest (Conservation) Act in 1980. Under the provisions of new act, prior approval of the Central Government required for diversion of forest lands for non-forest purposes.

Biodiversity Act, 2000

India is one of the twelve mega- biodiversity countries of the world and became a party to the International Convention on Biological Diversity. Following this a National policy and Action Strategy on Biodiversity, which seek to consolidate the ongoing efforts of conservation and sustainable use of biological diversity and to establish a policy and programme released by the Government of India on May 2000. To achieve these goals Biodiversity Bill 2000 was introduced. This act seeks to check bio-piracy, protect biological diversity through a three-tier structure of central and state boards and local committees. The National Biodiversity Authority (NBA) will deal with all cases of access by foreigners. Its approval will be required before obtaining any intellectual property right on an invention based on a biological resourced from India, or given in other countries.

National Environmental Tribunal Act of 1995

In 1995, the Central Government established the National Environmental Tribunal (through the National Environment Tribunal Act 1995) to provide for strict liability for damage arising out of accidents caused from the Handling of Hazardous substances.

National Green Tribunal Act, 2010

The National Green Tribunal has been established in 2010 under the National Green Tribunal Act 2010.

Objectives of the Act

- To the effective and expeditors disposal of cases relating to environmental protection.
- Special emphasizes to the conservation of forests and other natural resources including enforcement of any legal right relating to environment.
- Providing relief and compensation for damages to persons and property and for matters connected or incidental thereto.
- To handle environmental disputes involving multi-disciplinary issues.
- To dedicate jurisdiction in environmental matters for speedy and to establish environmental justice.
- To mandated to endeavor for disposal of applications or appeals finally within 6 months of filing of the request.

NGT Centers

The New Delhi is the principal place of sitting of the Tribunal and the following four places as sitting of the Tribunal

(i) Bhopal

(ii) Pune

(iii) Kolkata

(iv) Chennai.

Others Legislations related to Environment

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

(ii) The Manufacture, Storage and Import of Hazardous Chemical Rules of 1989 The main objective of the act is to inspect the industrial activity competent with hazardous chemical and storage facilities

(iii) Cells Rules 1989 This act was passed with a view to protect the environment, nature and health in connection with the application of gene technology and micro-organism.

(iv) Biomedical Waste (Management and Handling) Rules 1998 This act serves as a legal binding on the healthcare institutions with intent of streamline the process of proper handling of hospital waste.

(v) Recycled Plastic Manufacture and Usage Rules (1999) These acts were introduced to prohibit the usage of carry bags or containers made of recycled plastic for food stuffs. Rules also lay down procedures for the manufacture of virgin and recycled plastic carry bags and recycled plastic containers.

(vi) Municipal Solid Wastes Rules 200 According of these rules any municipal solid waste generated in a city or a town, shall be managed and handled in accordance with the compliance criteria and the procedure laid down in schedules of these rules. The waste processing and disposal facilities to be set up by the municipal authority on their own or through an operator of a facility shall meet the specifications and standards as specified in schedules.

4.12 Enforcement of Environment Legislation in India

Ministry of Environment, Forest and Climate Change

Introduction

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-coordinating the implementation of India's environmental and forestry, policies and programmes. The ministry also serves as the nodal agency in the country for the United Nations Environment Programme (UNEP) and other International Organisation related to Environment and Development.

Objectives

- Conservation and survey of flora, fauna, forest and wildlife.
- Prevention and control of pollution.
- Afforestation and regeneration of degraded areas.
- Protection of the Environment
- Ensuring the welfare of animals.

These objectives are well supported by a set of legislative and regulatory measure, aimed at the preservation, conservation and protection of the environment.

Central Pollution Control Board

Central Pollution Control Board, is a statutory Organisation was constituted in 1974 under the Water (prevention and Control of Pollution) Act 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of pollution) Act, 1981.

It serves as a technical service to the Ministry of Environment and Forests of the provisions of the Environment (protection) act 1986.

Objectives

Central Pollution Control Board functions was spelt out in the Water (prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution)Act, 1981.

(i) To promote cleanliness of streams and wells in different areas of the state by prevention, control and abetment of water pollution.

(ii) To improve the quality of air and to prevent, control or abate air pollution in the country.

Functions of the Central Board at the National level

- Advise the central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.
- Plan and cause to be executed a nation- wide programme for the prevention, control or abetment of water and air pollution.
- Co-ordinate the activity of the state Board and resolve disputes among states.
- Provide technical assistance and guidelines to the State Boards to carry out and sponsor investigation and research relating to problems of water and air pollution and for their prevention, control of abetment.
- Plan and organize training persons engaged in programme on the prevention, control or abetment of water and air pollution.
- Organize through mass media, a comprehensive mass awareness programme on the prevention, control or abetment of water and air pollution.
- Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abetment.
- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts.
- Lay down, modify or annul in consultation with the state governments concerned the standard for stream or well and lay down standards for the quality of air.
- Evolving efficient methods for disposal of sewage and trade effluents on land
- To develop, reliable and economically viable methods of treatment of sewage, trade effluent and air pollution control equipment.
- Access the quality of ambient water, air and inspect waste water treatment installations, industrial plant.

National Air Monitoring Programme

Air quality Monitoring is an important part of the air quality management. The National Air Monitoring Programme (NAMP) has been established with objectives to determine the present air quality status and trends to control and regulate pollution from industries and other source to meet the air quality standards.

Water Quality Monitoring

Water quality monitoring is an important part of the water quality management. Fresh water is a finite resource essential for use in agriculture, industry, propagation of wildlife & fisheries and for human existence. India is a riverine country. It has 14major Rivers, 44 medium rivers and 55 minor rivers besides numerous lakes, ponds and wells which are used as primary source of drinking water. Most of the rivers being fed by monsoon rains, which are limited to only three months of the year, run dry throughout the rest of the year often carrying waste water discharges from industries, endangering the quality of water resources. To abate this situation, the Water (prevention and control of pollution) Act, 1974 was passed with a view to maintaining and restoring water bodies. One of the Mandate of CPCB is to collect, collate and disseminate technical and statistical data relating to water pollution. Hence Water Quality Monitoring and surveillance system is constituted.

4.13 Conclusion

Ethics is a framework for understanding and evaluating human behavior decisions and actions in terms of their moral implications. Environmental ethics considers the ethics implications of human activities that impact ecosystem, species and the earth and natural resources. Environmental ethics is an emerging discipline in both academia and research institutions. It understands the human endeavor on environment through ethical paradigm. The Indian way of seeing Environmental ethics is so much relevant in the present fractured and crocked generation of environmental exploitation. The post Independent India also responded efficiently in tackling the environmental issues with sustainable principles.

4.14 Let Us Sum Up

The unit environmental ethics highlighted the core concept of sound and desirable actions towards environment. The main component

of environmental ethics is built on sustainable principle. The present exploitative society should learn from our ancestors approach to Environment. India is the land of multiple religions, have aligned his environmental principles its religion values. For our ancestors environment is an intrinsic element of human existence. They haven't dissect the Human and environment, rather they visualizes environment as an intrinsic with human subsistence. Our land promulgated a new approach to environmental ethics by initiating the discourse of religious environmentalism. Like Braduel theory the environment is highly corroborated with the human social, cultural and political developments. Through various environmental policies and legislations Indians have trying utmost to prevent and conserve environment from mad and unethical approach towards environment. With regards to the policy and other legislations passed from union government encourages stewardship and people participation as ideal environmental ethical practices of Indian subcontinent.

4.15 Self-Assessment

1. Define the scope and characteristics of Environmental ethics.
2. Summarize the principles of environmental ethics.
3. Define religious environmentalism in Indian context.
4. State the Buddha theory of Interdependence on environment.
5. Explain the Ahimsa as factor towards environmentalism.
6. Bring out the concept of environmental ethics in Hindu religion.
7. Define the aintinnai concept of environmentalism of ancient Tamils.
8. Describe Environmental aesthetic of Tamil culture.
9. List out the Environmental policies and law passed in Colonial India.
10. Explain Independent India's Environmental policy and legislation.

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UNIT – V

Lesson 5.1 - Urban Environment and Health

Structure

5.1: Learning Objectives

The main objectives of this unit are

1. To understand the dynamics of an urban environment
2. To analyse the Indian Urban situation and its challenges
3. To comprehend the challenges facing our environment
4. To understand the need and measures to conserve the biodiversity of the planet
5. To assess the environmental factors affecting human health

Key words

Urban environment, Baseline data, slums, climate crisis, global warming, pollution, health hazards.

5.2 Introduction

An urban environment refers to the human made or human modified surroundings associated with cities and towns. It is marked by distinct characteristics that differentiate it from rural and natural environment. Urban Environment in a very broad sense consists of resource, human and other processes that convert these resources into various other useable products and services. The intersection and overlap of the natural environment and socio- Economic actions constitutes the urban environment. India's urban system comprising 7,932 cities and towns, with a population of 3771.16 mn (Census 2011) is the second largest in the world. According to the UN, urban India will account for close to 50% of its total population by 2046.

5.3 Urbanisation – Composition of Baseline Data

The global population has been growing rapidly in the recent decades, especially in developing countries. This has caused corresponding growth in Urbanisation. The population gravitates toward urban centres in search of employment opportunities and a better standard of living. Urbanisation is widely recognized as the best solution to deal with the World's population growth as infrastructure can be focused and optimized to deal with the requirements of a dense population much more efficiently than to a dispersed population.

Urban Environment Baseline

An Urban natural environment baseline refers to a comprehensive and detailed assessment of the current conditions of a specific area or ecosystem. This baseline data serves as a reference for evaluating change and impacts on the environment over time. It is an important data in environmental conservation and decision making.

Components of Baseline Data

1. Physical Characteristics

This includes information about

(a) Landforms

(b) Geology

(c) Soil Types

(d) Water bodies

(e) Climatic conditions.

It provides an understanding of the physical aspects of the environment.

2. Biodiversity

This includes documenting the species of plants, animals and other organisms present in the area. This data also includes identifying both common and rare species, as well as their distribution and abundance.

3. Ecosystems

Describing the different ecosystems and habitats within the area such as

a. Forests

b. Wetlands

c. Grasslands

d. Aquatic environment

It helps us to understand their structure, composition and functionality in urban space.

4. Land Use and Land Cover

This data is used to identify how the land is currently used, such as

a. Topography

b. Agriculture

c. Residential

d. Industrial

e. Natural ecosystem

5. Natural Resource Inventory

This data is to identifying and quantifying natural resources in the specified areas such as

a. Water

b. Minerals

c. Timber

d. Fisheries

6. Hydrology and Water Resources

This data analyses water sources such as

a. Drainage

b. Rivers

c. Lakes

d. Aquifers

The water quality data will also be collected, especially important for areas where water resources are vital.

7. Climate Data

Collecting historical weather and climate data for the area including

a. Temperature

b. Precipitation

c. Climate Trends.

The purpose of establishing environmental baseline is very crucial for carrying out the assessment of the environment and the Socio—economical activities based on the data.

1. Environmental Impact Assessment

It serves as a reference point to evaluate the potential impacts of development projects or activities on the environment. By comparing the baseline with post-development condition, decision- makers can assess the environmental consequences of proposed actions.

2. Conservation and Biodiversity Management

The Environment baseline is essential for conservation efforts. It helps in identifying and prioritizing areas for protection, monitoring changes in biodiversity and setting conservation goals.

3. Sustainable Resource Management

The baseline Data aids in managing natural resources, its sustainability by understanding their current state and trends. This data is critical for industries like forestry, fisheries and agriculture.

4. Land Use Planning

The Environment Baseline data informs land use and zoning decision, promoting informed and sustainable urban or rural development.

5. Climate Change and Resilience Planning

The Environment Baseline is valuable for monitoring and mitigating the effects of climate change by tracking temperature changes, sea- level rise and other environmental indicators.

Challenges of Urban Environment

Rapid growth of the urban population is putting tremendous pressure on urban infrastructure, services and environment. The growth of slums without the minimum basic service is a serious challenge in the urban development policy. The social, economic and physical deprivation in the slums is widening the gap between the rich and the poor.

1. Unplanned Development

Urbanisation entails the optimization or intensification of infrastructure of an existing or upcoming urban area, and pushing the geographical boundaries of urban centers to accommodate its constantly increasing population. As the city expands its municipal boundaries, it must be in a position to provide basic physical facilities like electricity, transport infrastructure such as road or rails, clean drinking water, communication, infrastructure in most cities. Often investments in infrastructure occur once the population has already moved in and the authorities do not have the time to plan future capacity or execute project to adequately address existing concerns.

2. Growth of Slums

The United Nations defines slums as heavily populated urban areas characterized by substandard housing and squalor. They are vast informal settlements that have become the most visible manifestation of urban poverty in developing world cities. Almost an exclusively urban phenomenon, slums proliferate in cities where the existing housing, transport, health and sanitation infrastructure is too costly and inadequate for the growing population. The slums challenge continues to be one of the faces of poverty, inequality and deprivation in many cities n developing countries.

Problems associated with growth of Slums

Urban Poverty

Urban Poverty in the country is quite evident with 26.4 percent earning less than 1 dollar a day. 80 percent of the urban poor live in cities with a population of less than 1 million. The extent of informality observed in urban employment is quite high with a considerably low wage structure, adverse service conditions and location outside the purview of the social safety net. Crowding and lack of sanitation characterized by extremely

small living quarters, common space and near absence or shortage of running water are some of the predominant problems. Urban resources such as water, power and open spaces are scarce and access to these is usually highly skewed toward the more privileged.

Slum dwellers rarely have access to running water or basic sanitation and health infrastructure such as toilets, hospitals and waste disposal. This frequently leads to an outbreak of diseases such as jaundice, cholera and malaria.

Unemployment

Despite the fact that urban areas are hotbeds of economic activity and provide prolific employment opportunities, the number of people competing for jobs is often more than the jobs available. The largest category of urban employment is non-trade services, which includes large scale informal employment comprising primarily of domestic workers and rag-pickers. Unemployment is thus an inevitable problem and globally slums are home to the unemployed due to the marginal cost of living.

Density

Indian cities are among the most densely populated in the world. The current population density of Mumbai is ten times that of New York. The poverty stricken northeastern part of Delhi has the highest population density in the country which is sixteen times the average stipulated in the master plan of Delhi.

Crime

Slum conditions make maintenance of law and order difficult. Unemployment and poverty force people into anti-social activities and slums thus become a breeding ground for criminal activities.

Conflict with Environment

Humans are the dominant species on earth and thrived over the ages because of the ability to alter the environment. Urban areas represent the largest concentration of human societies and invariably have the greatest impact on the surrounding environment. Human activity in urban areas isn't directed and regulated through appropriate infrastructure can cause substantial damage to the natural environment and this damage increase with rising population.

Some challenges that uncontrolled urbanisation includes

Inadequate sewage facilities (leading to polluted Water) Unregulated growth leading to housing being built in environmentally sensitive areas Lack of availability of gas or electricity leading to intensive cooking with wood fires that seriously compromises air quality. Following are some of the environmental phenomena that occur due to the proliferation of urban areas.

Air Pollution

Air pollution occurs due to harmful emissions of gases and smoke from factories and vehicles. Air pollution can be defined as the emission of harmful substances to the atmosphere. The main factors for the pollutions are:

Sulphur Dioxide (SO2)

Nitrogen Oxide (NOx)

Ozone (O3)

Particulate Matter (PM- small suspended particles of varying sizes)

The World Health Organisation (WHO) highlights air pollution as the greatest environmental risk to human health. It is estimated to be the cause of 7 million premature deaths every year. A study conducted by the Lancet Journal concluded that over 1.2 mn Indians are estimated to have died prematurely in 2017 due to air pollution.

Water Pollution

Water pollution comes from the three main sources in urban settlements.

Sewage

Industrial effluents

Runoff from agricultural activities.

Water pollution from domestic and human wastewater causes many severe water borne diseases. The problem of water pollution due to industries is because of the inadequate measures adapted for effluent treatment than to the intensity of industrial activities. The quantity of sewage and liquid wastes from human settlements and uncontrolled industries generated through industrial activities. The water quality is affected due to the inadequate availability of basic facilities and rapidly increasing population.

Water supply and sanitation facilitates are probably the most critical factors that sustain urban life, regardless of income status. Urban areas have the potential to waste and pollute water in many ways. According to the water and sanitation programme administered by the World Bank, the amount of non-revenue water which basically means water unaccounted for and wasted. Waste –water from streets carries oil, rubber, heavy metals and other contaminants from automobiles. Untreated or poorly treated sewage can be high in pollutants such as fecal coliform bacteria, nitrates, phosphorus, chemicals and other bacteria. Ground water and surface water can be contaminated from many forces such as garbage dumps, toxic wastes and chemical storage and use areas, leaking fuel storage tanks and intentional dumping of hazardous wastes. Urban water pollution is a growing problem in developing countries of the world. Indian cities are among some of the most polluted urban centers around the globe.

Sewage

Densely populated areas require adequate sewage facilities as well. Due to the lack of municipal sewage treatment, human waste has become one of the largest contributors to the pollution of water bodies in urban areas. According to the Central Pollution Control Board, untreated waste is the largest source of water pollution in India. Canals, rivers and lakes in cities of developing countries often serve as dumping grounds for sewage, solid and liquid wastes as efficient garbage or effluent disposal infrastructure

Domestic Hazardous Waste

Types of domestic hazardous waste generated

- Aerosol cans
- Batteries, car batteries, oil filters and car care products and consumables
- Bleaches, household kitchen and drain cleaning agents.
- Oil Chemicals and solvent and their empty containers.
- Cosmetic items, chemical-based insecticides and their empty containers.
- Medicines including expired medicine, pesticides and herbicides and their empty containers.
- Paints, oils, lubricants, glues, thinners and their empty containers.

- Photographic chemicals
- Soft foam packaging from new equipment
- Thermometers and mercury containing products.

5.4 Indian Urban Environment

In the Indian context urban settlements can be classified into the following types:

Census Towns: The areas having a population of at least 5000 and density of at least 400 per sq km and at least 75% of the male population is engaged in non-agricultural activities.

Statutory Towns: The towns which is run by a local government – corporation or municipality.

Satellite Town – A town located in the proximity of a larger urban area and depends on it for socio-economic activities.

Urban Agglomeration – A continuous urban area, either city or town whose outer areas i.e., the suburban areas or the rural areas are part of the administrative boundaries of nearby urban area.

Outgrowth – The growth of small settlements that grows out of the large town or city and is treated as a separate administrative unit.

Over urbanisation - This refers to the urban areas whose resources are over utilized and the areas are well-developed.

Suburbanisation – The process where the adjoining rural area start to become urbanized.

Counter urbanisation – The process of movement of people from urban to rural areas.

Unique Features of Indian Urbanisation

The process of urbanisation in India is unique and dynamic. Certain features are characteristic to Indian urbanisation. The urbanisation in India is taking place at a rapid rate. It is estimated that by 2047, India's urban population will double itself. **The rapid rate of urbanisation** results in rapid growth of cities at an unprecedented pace. This rapid growth tends to push the majority of the urban population into **informal settlements** which lack basic amenities. In India urbanisation takes place mainly due to the presence of the **tertiary sector,** such as communication, transport, construction etc., rather than the secondary sector of economic activity.

Due to the vast land area, we can find different forms of **cities co-existing** in this country. Cities like Varanasi, Jaipur, Haridwar, Hyderabad and Mysore have rich cultural heritage and history and they co-exist with fast-paced and developed cities like Mumbai, Chennai, Bangalore etc. Also, the **geographical difference** is a unique feature of our cities. Cities in the south and western part of the country are more urbanized than the cities in the North and the Eastern part due to various reasons such as, historical background, sociocultural outlook and availability of resources.

Regulating Urbanisation in India

Recognizing the vast impact that Urbanisation has on the environment, the Indian Government committed to United Nation Framework Convention on Climate Change (UNFCCC) in 2015. India determined with it policies and programmes on promotion of clean energy, resilient urban centers, promotion of waste to wealth, safe, smart and sustainable green transportation network, abetment of pollution and efforts of fight the build-up of carbon by enhancing the carbon sink through creation of forest and tree cover. The Government of India has launched various programmes to address urban governance issues and gaps in infrastructure. Some of the key programmes include

(a) Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

(b) Heritage City Development and Augmentation Yojana (HRIDAY)

(c) Smart Cities Mission

(d) Clean India Mission

(e) R-Urban Mission

(f) National Clean Energy Programme (NCAP)

The Government's Commitment to address pollution can also be seen in its increased budgetary allocation for Environment for fiscal by 10.4 per cent to 29.5 bn for Financial Year 2020. There was also an allocation of INR4.6 bn for pollution control schems including National Clean Air programme.

5.5 Urban Development Schemes

Year	Schemes	Objectives
1992	The 74th Constitutional Amendment Act	Empowering Municipalities functionally, financially and politically
2002	Urban Reform Incentive Fund (URIF)	Eliminate systematic weaknesses to strengthen Municipal finance and functioning
2005	Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	Eliminate Structural and Systemic weaknesses to create an investment climate and to improve local governance and finance
2007	National Urban Housing and Habitat Policy (NUHHP)	Affordable housing for all with emphasis on vulnerable sections of society
2011	Rajiv Awas Yojana (RAY)	Working towards Slum free cities via property titling and tenure security
2013	National Urban Livelihoods Mission	Reducing urban poverty by providing access to employment
2014	Swachh Bharat Abhiyaan (Clean India Mission)	Providing access to scientific sanitation and management of solid waste
2015	Smart City (Development of 100 smart cities)	Enhance the quality of urban life and provide a clean and suitable environment by employing smart solutions for the efficient use of available resources and infrastructure.
2015	Atal Mission for Rejuvenation and Transformation of 500 cities with over 100,00 population(AMRUT)	Create infrastructure that has a direct link to the provision of better services to the people by applying reforms to improve service delivery and make municipal functioning transparent and accountble

2015	Pradhan Mantri Awas Yojana (Housing for all)	Address the housing requirements of the urban poor including slum dwellers by promoting slum rehabilitation and affordable housing in partnership with the private sector and providing subsidies such as the credit linked subsidy for beneficiary-led housing construction or enhancement
2015	Heritage City Development and Augmentation Yojana (HRIDAY)	Supporting core infrastructure aimed at revitalization of areas close to heritage sites by focusing on water supply, sanitation, landscaping and tourist conveniences.
2016	RURBAN Mission	Accelerating rural development and providing basic urban services

5.6 Environmental Challenges and Countermeasures of Urban India

Urbanisation is a major driving force behind Indian Economic growth and contributes close to 60 % of nations Gross Domestic product. However when compared to other large Asian economies, Indian Urban centers are underperforming. There exist large, untapped economies which require effective interventions in the spheres of urban and spatial planning, urban land markets and governance. There are some major hurdles faced by Indian urban centers and measures taken by the government address them.

Urban air and water pollution

Studies on cities and their environment have established the significant economic cost that the country bears on account of poor air and water quality. Several steps have been taken to address environment related issues which mainly include a National Mission on Sustainable Habitat.

The main objectives of National Mission on Sustainable Habitat mission are

(i) Promotion of energy efficiency as a core component in urban planning.

(ii) Enforcement of fuel efficiencies.

(iii) Management of Urban waste.

(iv) Promotion of public transport.

(v) Reduction of subsidies on unclean fuels.

Measures to address air pollution

The major factors for air pollution in Urban India are

1. Increase in ownership of private vehicles
2. Inadequate arrangement for waste disposal
3. Growing mobility demands
4. Growing demand for power and industrial demand
5. Unplanned development of industries
6. Hazardous industrial waste
7. Inefficient use of energy in buildings
8. Excessive use of biomass for cooking and eating

These are the major reasons for the increase in air pollution in urban areas of India. The government of India has taken the substantial steps to combat air pollution in urban centers in recent years:

- National Air quality Index (NAQI) was launched to evaluate the status of air pollution in cities.
- Continuous Emission Monitoring System (CEMS) mandates the highly polluting industries to install real tie monitoring of emission and effluent discharge points.
- Faster Adoption and Manufacturing of Hybrid and Electric Vehicles Scheme (FAME) offer incentive to the owners of electric / hybrid vehicles.
- The Green India Mission (GIM) launched in 2015 aims to increase the forest/tree cover up to 5 million hectares.
- India aims to improve fuel standards by switching from Bharat Stage 4 (BS 4) to Bharat Stage 6 (BS 6) norms across the country, for petrol vehicles required to be 25 percent cleaner by reducing NOx (Nitrogen Oxide) numbers from 80 mg/km to 60mg/km.

- Auto LPG Dispensing Stations (ALDS) have been established in 232 cities and towns to increase the acceptability of lesser polluting LPG vehicles.
- Currently 586 ambient air quality monitoring stations are operational covering 246 cities, towns and industrial areas.

Measures to address water pollution

In India, it is estimated that about 62,000 million litres per day (mld) of wastewater is generated in the Urban centres. The untreated wastewater is a major source of pollution of surface water bodies and rivers, and there is an urgent need for augmenting the treatment capacity and promoting the recycling and reuse of treated water.

- Common Effluent Treatment Plants (CETPs) are being set up to the treat the effluent emanating from clusters of compatible small-scale industries. According to Central Pollution Control Board, 193 Common Effluent Treatment Plants were installed in the country a on 2016, with a combined capacity of 1,474, million liters per day.
- The National Lake Conservation Plan (NLCP) and National Wetland Conservation Programme have been implemented and integrated with a National plan for conservation of Aquatic Eco-systems to undertake various conservation activities including Lake Beautification, biodiversity conservation, awareness creation and community participation.
- The National Water Mission has been formed to conserve water, minimize waste and ensure equitable distribution through development and management of integrated water resources.

Solid waste Management

As per estimates, 115,000 tons of municipal solid waste is generated per day in India. It is estimated that the solid waste generated in small, medium and large cities and towns in India. The estimated annual increase in per coati waste quantity is about 1.33% per year according to National Environmental Engineering Research Institute. According to the Urban Development Ministry, just 4 % of the solid waste generated in the country is treated and remaining wastes are dumped unscientifically and leads water and soil contamination. The ministry estimates that the volume of solid waste generated in cities will increase to 0.5 million tonnes per day by 2030 as people move from villages to cities.

Measures taken to manage Solid waste

Solid Waste management (SWM) projects in the country have been provided significant budget outlays over the years.

The Union Ministry of Environment Forests and Climate Change has notified the Solid Waste Management Rules, 2016. This document provides a detailed framework (segregation, transportation, treatment and disposal) for waste management in every urban local body.

According to the CPCB, the total quantity of Bio- Medical waste generation in the country is approximately 517 tonnes per day. The Bio-Medical Waste (Management and Handling) Rules and Plastic Waste Management Rule have been implemented since 2016. To grapple with the manifold increase in the generation of Bio- Medical

Waste (BMW), 199 Common Bio- Medical Waste Treatment Facilities are in operation.

The Environment Ministry has notified e- Waste Management Rules 2016. The new rules have provisions for financial penalty for damage caused to ecology and any third party due to improper management of e-waste.

The Swachh Bharat Mission (Clean India Mission) had an objective of making the country clean and litter free with scientific solid waste management in about 4,041 towns covering a population of 306 million. It aimed to construct 10.4 million individual household toilets and 0.5 million community and public toilets. It also aimed to implement 100 percent door-to-door waste collection and transportation of wastes in all cities.

5.7 Critical Issues

The environment in which we are living caters to our needs, both as an individual and as a community. Man has progressed through several levels of civilization by relying on the resources provided by our environment. From a huntergatherer to living in a settled civilization human kind has made huge leaps and bounds in reaching to the present stage of civilization. One of the most important phases of human development was the Industrial Revolution. This part of history saw tremendous shift in the socio-economic patterns of the society and also brought a revolutionary change in the political scenario. This shift was beneficial in many ways and saw great progress in the economic trends. The coming up of industries

started to ease the process of manufacturing, the greater number of goods and products needed more raw materials and markets, the search for these led to new forms of imperialism, capitalism was on the rise, the new class of nouveau riche increased the demand of goods, especially luxury goods, which led to lot of research and development in these products and as a result rich capitalist countries started to become richer and more dominant.

The rise of factories and industries, created lot of employment opportunities for the people. This acted as pull factor, leading to thousands and thousands of rural populations to migrate towards the centres of production. This in turn led to the rise of unplanned cities, bringing along problems of housing, sanitation and unhygienic conditions of living. The ensuing problems of imperialism led to conflict among nations leading to wars very destructive in nature. Thus, an entire chain of reactions was triggered giving rise to new forms of progress and development.

In the background, what actually got affected was the environment. Growth and progress in industries, leading to several tremendous changes, began to build their demand on the natural resources. Growing population, rise in the concentration of people in cities and demand for goods and products became the major cause for the pressure on the resources. Since then, the natural resources have been utilized in such a manner that many of them are nearing extinction and even renewable resources like water are facing a challenge of not being consumable any more. This is the critical nature of the situation we are facing right now. In this lesson we will discuss more about the crisis that our environment is facing.

5.8 Climate Crisis

Climate change is a natural process. It is the modification that occurs in the Earth's climate. These changes take place due to the changes in the atmosphere. Changes in other geological, chemical, biological and geographical factors also bring about climate change. There are two categories of factor that affect climate change. The Natural factors that bring an impact is a very slow and gradual process that affect the climate over a period of thousands to millions of years. Continental Drift is such an example, where we witness, landmass drift apart. This process occurs very slowly, almost unobserved and takes a very long period. The impacts that the continental drift brings are varied. There is change in the physical

features and positions of water bodies and changes in ocean currents and winds. These changes bring a great impact on the climatic condition of a geographical region. The rise of Himalayas is a classic example of continental drift and that has brought in several changes in the pattern of the rivers, the snow-clad mountains, giving rise to glaciers, etc.

Volcanic eruptions are also natural phenomenon which occur due to the disturbances in the earth's core. During a volcanic eruption large volume of dense gases and dust particles are emitted which causes severe impact on the climate. The dense gases and dust block the heat and light from the sun, leading to change in the weather conditions and influences the weather patterns in the region. **Milankovitch cycles** are caused by variations in the Earth's orbit which also is a factor for climatic change. **Changes in Earth's orbit** is caused due to variations in earth's eccentricity, variations in the tilt angle of the Earth's axis of rotation and precession of Earth's axis. These factors bring a change in the seasonal distribution of sunlight reaching earth's surface and the results in climate change. These changes occur very gradually over a period of thousands of years and have tremendous impact on the climate.

Man-made factors that being climatic change are also termed as Anthropogenic factors and lead to the increase in global surface temperature. The three major factors that imply man-made activity are emission of Greenhouse gases, Atmospheric Aerosols and Shift in land-use pattern. The green house gases absorb the radiation form the sun and cause an increase in the global temperature. The more the emission of these gases, the more the increase in the temperature of the earth. In case of atmospheric aerosols, they absorb the solar radiation and do not let the radiation be absorbed by the earth's surface. This has a very strong impact on cloud formations and can cause them to be transported thousands of kilometers away through winds and circulations in the atmosphere. Change in the land use pattern has adverse effects on the climate. Forest covers and land covers are being increasingly cleared for domestic and industrial purposes. This practice increases the rate of solar energy absorption and the amount of moisture evaporated. This will lead to an increase in the temperature.

Effects of Climate Change

The most important impact that can be felt is the rise of the global temperature. There is an average increase of 1.62 degrees Fahrenheit since

the 19th century. The change has been more rapid in the last five decades and is continuing. This has led to the warming up of the oceans by 0.4 degrees Fahrenheit since 1960's. This brings us to the next important impact which is the melting of the ice sheets. It is recorded that Greenland lost an average of 286 billion tons of ice between the period of 1993 to 2016 and Antarctic lost nearly 127 billion tons of ice and the rate has tripled in the last decade (Data from NASA's Gravity Recovery and Climate Experiment). All over the world glaciers are retreating and satellite imageries record the decrease in the snow cover in the Northern Hemisphere. The extent and thickness of Arctic Sea ice has also declined rapidly over the last few decades. This gives rise to even bigger challenge, that is the rise of sea levels. In the last century global sea level rose by 8 inches, but in the last two decades the rise in the sea level is nearly double than that of the last century and is increasing more every year.

The United Nations Secretary-General Antonio Guterres in his address to the 26th session of the Conference of the Parties (COP26) in Oct, 2021 stated that, "Our fragile planet is hanging by a thread. We are still knocking on the door of climate catastrophe. It is time to go into emergency mode – or our chance of reaching net-zero will itself be zero." The situation is very depressing, yet there are lot of things which each one as an individual can do to save the planet. Niklas Hagelberg, UNEP's Climate Change Coordinator states, "The climate emergency demands action from all of us. We need to get to net zero greenhouse gas emissions by 2050 and everyone has a role to play. We, as individuals, must change our consumption habits and pressure those who represent us – our employers, our politicians – to move rapidly to a lowcarbon world" Some of the ways that we can help in reducing global warming are:

Use of renewable energy resources – Use of solar power or other zero-carbon energy resources. This will cut down carbon emission. The use of fossil fuel has to be reduced, which will also help in reducing the carbon emission. Switching off appliances and light when not in use, insulating the roof to maintain the temperature naturally are some very basic measures which every individual can contribute.

Mode of transport – Choosing the right mode of transport is another way to contribute. Avoid single vehicles for short distance travel. Choose to walk or cycle, use of public transport systems and carpool so that we can reduce the number of vehicles on the road. Use of electric vehicles is also a better option.

Our Food/Diet – The food we eat is also a great contributor to climate change. Plantbased diet will be more sustainable to our environment, since 60 percent of world's agriculture land is used for livestock grazing. Rearing, processing, preserving and transporting of animal-based food also involves lot of energy requirements. Opting for plant-based meals will be healthier for the human body and the planet earth. Another way to reduce food's carbon foot print is to opt for local and seasonal food. This will encourage sustainable agriculture and reduce emission of fossil fuels. Further, measures like community gardening will help in improving the biodiversity of a region. Wastage of food should be avoided at all cost. According to UNEP's Food Waste Index Report 2021, 1 billion tones food is wasted each year globally. This itself amounts for 8% to 10% of global greenhouse gas emissions.

Planting Trees – The major cause for the rise in global temperature is deforestation. Each year we are losing approximately 12 million hectares of forest which contributes to 25% of greenhouse gas emissions. This can be reversed by planting more trees, either individually or collectively as a community.

The increase in global temperatures is resulting in extreme climate events like droughts, extreme rainfall and heat waves. This is due to human influence which has led to rapid changes in the atmosphere, lithosphere and the biosphere. Countries across the globe have realized the ill effects of rise in the global temperatures. At the United Nations Framework Convention on Climate Change Conference of Parties in 2015 (COP21) held in December, 2015, **The Paris Agreement** was adopted. 196 countries are signatories to this Agreement. It is a legally binding international treaty on climate change. It came into force on 4 November 2016. The major goal is to hold "the increase in the global average temperature to well below 2ºC above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5ºC above prindustrial levels". This level was fixed as the UN's Intergovernmental Panel on Climate Change indicates that crossing the 1.5ºC threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall. The Paris Agreement provides a framework for financial, technical and capacity building support.

Harnessing solar energy and making it available for human use is the best alternative to the existing use of energy from the fossil fuels. It is stated that all the energy that human race uses in a year is equal to the

energy that reaches from the sun to the earth in one hour. If this energy could be harnessed and used by all nations across the globe it will help to reduce the greenhouse gas emission and save the planet earth. One Sun, One World, One Grid is the new initiative announced in COP26. Nearly 80 countries are signatories to the One Sun Declaration. This initiative will bring together governments, financial institutions and power system operators to work together to realize the targets of the Paris Agreement and prevent the irreversible damages of dangerous climate change and help to achieve the Sustainable Development Goals.

5.9 Pollution

The introduction of harmful contaminants into the natural environment is known as Pollution. The substances which harm the natural environment are termed as Pollutants which can be in any form – solid, gaseous, liquid or also in the form of energy. These substances cause undesirable change in the physical, chemical or biological composition of the atmosphere, hydrosphere or the lithosphere. Pollutants are waste products or by-products which left untreated turn into pollutants and cause harm to the environment. There are different types of pollution which are either caused by natural events or human activities. They are classified as:

Air Pollution,

Water Pollution,

Soil Pollution and Noise Pollution.

In the present-day context, another rarest and deadliest form of pollution is Radioactive Pollution.The release of contaminants into the earth's atmosphere is termed as Air Pollution. The more the concentration of these contaminants, the deadlier is the effect of the pollution. The major causes for air pollution are of two forms – Natural causes (For example forest fires and volcanic eruptions) and Anthropogenic causes i.e., caused by human activities. The second form of causes are more and very harmful.

They are (i) Burning of Fossil fuels, (ii) Harmful gases from factories and industries,

(iii) Deforestation, (iv) Mining operations, (v) Agricultural wastes.

Burning of Fossil Fuels – Fossil fuels are the most necessary part of economic activity. These are the generators of energy and almost every

part of human activity requires this energy to function. They are essential for cooking, manufacturing, transport, research, agricultural activities. This was the most important invention which brought in large scale development and progress for the human civilization. The combustion of fossil fuels releases high amounts of greenhouse gases and this becomes a harmful contaminant polluting the atmosphere. Transport vehicles are the biggest source of carbon emissions.

Gases from factories and industries – These are very essential for the economic progress of the country, but they are environmentally hazardous. Industries and factories emit huge volumes of gases which are not absorbed into the atmosphere due to their large concentration. These disrupt the chemical composition of the atmosphere, thus making it polluted.

Deforestation – Trees absorb CO2 during the process of photosynthesis and release oxygen. The air gets purified and the levels of the gases in the atmosphere is maintained. Deforestation disrupts this process. Large number of trees are cleared for developmental purposes. The growing population requires land for settlement and other socio-economic activities. This leads to loss of trees and the ability of the environment to naturally purify itself is lost.

Mining – The process of removing the minerals from the surface of the earth is termed as mining. In this activity, toxic gases are released, which causes health hazard and death to the miners and also impacts the regions surrounding it. Huge volume of dust is also released in this process.

Agricultural Activities – One of the hazardous gases that is emitted during agricultural activity is Ammonia. Use of pesticides, insecticides and fertilizers also release harmful chemicals into the atmosphere and pollute it.

5.10 Effects of Pollution

One of the major effects of pollution is that it causes severe **respiratory diseases**. It is also the cause of **heart diseases and lung cancer**. Young children are prone to pneumonia and asthma in regions with air pollution. **Global warming** is a natural occurrence when air pollution takes place. The increase of greenhouse gases leads to increase of global temperature. This brings in other related impacts such as melting of glaciers and rise in sea levels, causing several coastal regions to be submerged. Release of chlorofluorocarbons, halons, aerosols directly

into the atmosphere results in **depletion of the ozone layer** which causes other harmful effects such as skin cancer. When water droplets combine with harmful gases such as nitrogen oxides and Sulphur oxides in the air, they become acidic and get released as **Acid rain** causing severe damage to human beings, plants, animals as well as architectural structures. Air pollution also has its impact on the plants and animals leading to the extinction of several species.

Water Pollution

Water is a renewable natural resource. One-third of earth's surface is covered by water. It is an important source, required for survival all the living begins. Though this resource is renewable, we are losing this resource very fast due to pollution. The contamination of water sources – surface water and ground water due to human activity is termed as water pollution. This adversely affects the composition of water, making it unfit for consumption and causing health hazards. Nature has a method of replenishing water source through a continuous pattern known as water cycle. Water on the earth's surface (oceans, seas, lakes etc.) turn into a gaseous state and evaporate into the atmosphere. There they condense and form into clouds and precipitate in the form of rain or snow and reach back to the earth. When this cycle gets affected, we face scarcity of the resource (ex. drought).

Water pollution is caused due to human activities. The main cause is directly letting out harmful affluents from factories and industries into the water bodies. This contaminates the water, changes its composition and makes it unfit for use. In many unplanned urban settlements, sewage water is directly released into water sources, thereby polluting it. In some regions indirectly pollutants enter the groundwater through seepage via groundwater or soil and pollute the ground water thereby making it unportable. Spillage of oil from cargo ships also cause pollution of water. Dumping of wastes into water bodies is the major cause for water pollution. It is estimated that nearly 6 billion kilograms of garbage is dumped into the oceans every year. Eutrophication is the process of large quantities of nutrients being released into water bodies. This causes rapid growth of algae which releases harmful toxins into the water body.

Effects of Water Pollution:

Several diseases are caused due to water pollution. Typhoid, cholera, liver diseases, etc., are caused due to contamination of water. It

causes harmful effects for the aquatic life. Their metabolism is affected and destroys them. Dioxin is a harmful chemical which can cause illness of various types ranging from reproductivity issues to growth of cancer cells. This chemical gets accumulated in aquatic beings and travels up the food chain and enters human bodies. Lead and cadmium are toxic substances which are released into water bodies causes these substances to travel through the food chain and is deposited in animals and human beings causing cancerous diseases.

Throughout history, we have witnessed several cases of water pollution. One very serious pollution crisis is that of River Ganges. It ranks sixth among the most polluted rivers of the world. The causes for pollution are the release of industrial effluents into the river water, religious ceremonies (burials and cremations on the shores). These has created serious ecological impacts and severe health hazards. The Ganges River shark and dolphin are endangered species, since polluting has impacted the aquatic flora and fauna of this region. Water, a very precious and valuable resource has to be protected against such harmful effects. Treatment of wastes before being let into water bodies is an important measure. Reusing, reducing and recycling of water wherever possible will help in reducing the harmful effects of water pollution.

Soil Pollution:

Contaminating the soil by addition of industrial and domestic wastes is known as soil pollution. Due to this the physical, chemical and biological composition of the soil gets affected and reduces the productivity of the soil. Formation of soil is a very slow natural process. Hence, if this resource is polluted, the productive regions will become barren and cause damage to the environment.

Excessive and improper use of pesticides, insecticides and fertilizers are the major cause for soil pollution. Effluents from the industries, their solid wastes also pollute the soil. Non-degradable substances such as plastics, metallic cans, leather products etc., which are discarded pollute the soil and make it unusable. Plastic constitutes major part of the solid waste as they are easy to manufacture and cheap. They have replaced metal and glass products. They are non-degradable and are creating a great havoc for the environment. Radioactive wastes from mining and nuclear power plants also make the soil unusable. Salinity of the groundwater also pollutes the soil and makes it unfit for agricultural use.

Reducing, reusing and recycling of wastes can help in minimizing soil pollution. Use of biogas from agricultural waste and animal refuse can protect the soil. Increased use of biofertilizers and adapting biological ways of controlling pests will help to reduce the pollutants in the soil. Wastes must be disposed by digging special pits. Use of recycled paper will help in saving trees from being cut and protect the soil from erosion.

Noise Pollution:

Unpleasant and undesirable sound which leads to discomfort is termed as Noise pollution. The word 'Noise' is derived from the Latin word 'Nausea' which refers to sickness. Sound is a form of energy and is measured in decibels (dB). Increasing decibels is a cause of concern and leads to health hazards. Major causes for noise pollution are (i) Transport, (ii) Industries and (iii) Gadgets. Noise from transport vehicles such as trains, trucks, buses, cars and planes has increased in the recent times due to the increase in the number of vehicles. Over usage and unnecessary of horns Noise from industries especially heavy industries has the ability to damage hearing to about 20%. Along from this noise from gadgets such as loudspeakers, air conditioners, vacuum cleaners, musical instruments etc., also cause noise pollution. Weddings, public gatherings, mining and construction sites are also areas where we can experience noise pollution.

Noise pollution can result in elevated blood pressure level, hearing loss, sleeping disorders and cardiovascular diseases. Prevention of usage of sound above the desired decibles is the only way to avoid noises pollution. Honking in public places like near hospitals, schools, colleges should be banned. Buildings should have sound proof systems. Usage of explosives in forest areas, mountainous regions and for mining purposes should be prohibited. Afforestation will help to minimize noise pollution, so planting of more trees in the neighbourhood should be encouraged.

Apart from the above-mentioned forms of pollution, nuclear pollution or radioactive pollution is also becoming very hazardous in today's context. Substances like radium, thorium and uranium contaminate the air, water and soil and makes it hazardous for the environment. This pollution can result from nuclear accidents, nuclear weapon testing or nuclear weapon disposal.

5.11 Conservation of Biodiversity

Biodiversity refers to the variety and variability of the living organisms and ecological complexes in which they are found. Diversity occurs within species and also between species and the ecosystem. It comprises of *Genetic Diversity, Species Diversity and Ecosystem diversity. Genetic Diversity* refers to the variety of genes within a particular species. For example, rice has several varities in terms of size, colour, flavour or disease resistance. New species are formed due to genetic variation. Species Diversity refers to the various species found in the region. Ecosystem Diversity refers to the variations in the biological communities in which the species live. The diversity within a community is termed as Alpha diversity, between communities is known as Beta diversity and diversity of habitats within a geographical area is termed as Gamma diversity or landscape diversity.

Earth is home to more than 1.7 million species of living organisms. India has a geographical area of 329 mha. All types of climatic conditions are present in this region and that provides biodiversity of a vast extent here. It is rich in natural resources and biological diversity. Biodiversity is essential for the health of the biosphere and it provides the raw materials for the human kind. They are of value to us both directly and indirectly. The basic need of food, fuel, clothing and other requirements such as medicine, timber are the products that we consume from our environment. It also provides regulatory, cultural and sustaining functions. The environment thus provides us **Consumptive use value**. Also, the products that we get from our natural resources and are used for commercial purposes are the **Productive use value** of the biodiversity. For example, tusk, ivory, honey, gum, resins, silk, wool etc. Such products are highly valuable resulting in illegal trade and smuggling.

Apart from this, we also have indirect benefits from our biodiversity. Such uses include, soil formation, waste disposal, recycling of nutrients and so on. The form broad forms of indirect values are **non-consumptive use value and Aesthetic, social and cultural value, Option value, Existence value and Ethical value**. The diversity that we get in our environment, brings all these benefits and adds to the quality of life. They provide some of the most beautiful and appealing aspects of life. Varieties of species of plants and animals are needed for their products, but several of them are appreciated for their beauty. They provide psychological and emotional restoration.

It is evident that a well-balanced biodiversity will lead to a good ecosystem. Thus, it is important to conserve the biodiversity. Conservation of biodiversity refers to the protection and management of the resources in such a manner so as to obtain the benefits from it in a sustainable manner both for the present and future generations. The objectives of conserving a biodiversity are, to preserve the diversity of sphere, sustainable utilization of available resources in an ecosystem and to maintain life-sustaining systems and ecological processes. The conservation of biodiversity can be done in two different forms - **in-situ conservation and ex-situ conservation.**

In-situ conservation occurs in places like biosphere reserves, wildlife sanctuaries, national parks, biodiversity hotspots, gene sanctuary and sacred groves. In this form, species are conserved within their natural habitat. It is protecting and maintaining the natural ecosystem. This is very cost-effective as well as convenient since the natural habitat is going to be preserved. The different forms of living organisms (flora, fauna, microorganisms in the particular biosphere) will be protected. The various species will also be able to evolve better in the natural surroundings. India has plenty of in-situ conservation spots.

Sundarbans, Nanda Devi, Nokrek and Manas are examples of **Biosphere Reserves**. These are large ecosystems (approx. 5000 sq.km.) where the traditional and natural habitat are protected. These are maintained under governmental protection. **Wildlife sanctuaries** are meant for the protection of wild animals. Little amount of human activity such as timber harvesting, collection of wood and other forest products is allowed here. These activities must be carried on without disturbing the wildlife present here. There are a total of 551 wildlife sanctuaries in India. Example are Ghana Bird Sanctuary, Abohar Wildlife Sanctuary, Mudumalai Wildlife Sanctuary. **National parks** are established and maintained by the government for conservation of wildlife and its environment. It is solely dedicated for preserving the fauna and hence human activity is restricted inside national parks. Thes conservation places occupy about 100-500 sq km and are set up in several places in our country. At present, India has national parks, with well protected boundaries, where human activities such as cattle grazing or cultivation are restricted. Example of National parks are Kanha National Park, Gir National Park, Kaziranga National Park.

The most important form of in-situ conservation is maintaining of Biodiversity Hotspots. These are places specifically designated for preserving habitats which has lost almost 70% of its cover and the region should have at least 1500 species of vascular plants i.e., it should have a high degree of endemism. They are critically in need of conservation. These areas are protected for various purposes such as to conserve the wildlife, domesticated plants and animals and inhabitant lifestyle. Example. The Himalayas, The Western Ghats, The Indo-Burma Region (North East) and The Sundaland (includes Nicobar group of Islands). These are four biodiversity regions in India. All over the world there are 36 biodiversity hotspots which is only 2.4% of the Earth's land surface but support half of the world's plant species as endemics and nearly 43% of bird, mammal, reptile and amphibian species as endemics. Gene sanctuary is meant only for the conservation of plants. India has only one **gene sanctuary** in the Garo Hills for conserving wild species of Citrus. **Sacred Groves** are protected areas by communities for religious beliefs. They are mostly part of the forest.

Ex Situ conservation is a methodology of breeding and maintaining endangered species in artificial environments like **zoos, nurseries, botanical gardens**, etc. The purpose is to create an artificial environment where survival struggles are less and complete care can be provided. In this form of conservation, artificial breeding methods can be introduced, which will enable to create many more offspring of the species. The population management of the endangered species can be maintained and illegal methods like poaching can be stopped. New technologies and innovations like gene techniques can be applied to increase the population of such species. In this protected environment it is conducive to provide life-sustaining conditions like food, climatic conditions and also medical support.

The purpose of conserving the biodiversity is to keep the ecological integrity intact. The threat to the ecosystem can be removed or at least minimized and the ecological processes can continue. It is an attempt to restore the population of species which are fast becoming extinct and integrate them back into the ecosystem. Through these processes it is expected to conserve the natural resources of a given biodiversity and utilize it an efficient manner. A threat to biodiversity is a threat to human species and hence it is very important to conserve and protect the biodiversity.

5.12 Environment and Human health

The Natural environment is a composition of the earth, air, soil, water and living organism called as biosphere. The composite nature and process of natural environment keeps the life in biosphere conducive and safe. The connection between protecting the natural environment and safeguarding human health is interrelated and intertwined. The effect of various environmental exposures as toxic chemicals, air pollution and biological agents on the human is perceived as the major problem in environmental health. Healthy and pollution-free nature allows humans to live longer and healthier lives. According to World Health Organisation, "Healthier environments could prevent almost one quarter of the global burden of disease". WHO also recommends following conditions to preserve natural environment which is a prerequisite for good health, they are

a. Clean air

b. Stable Climate

c. Adequate water

d. Sanitation and Hygiene

e. Safe use of chemicals, protection form radiation

f. Healthy and safe workplaces

g. Sound agricultural practices

h. Health supportive cities and built environment.

5.13 Environmental (polluted) Factors Affecting Human Health

Environmental factors can have a significant impact on human health. These factors can be both natural and man- made and can affect individuals on an individual level and community level. The key environmental factors that influence human health are

1. Air quality

Air pollution caused by emission from vehicles, industrial processes and other sources can lead to respiratory diseases like asthma and bronchitis. Particulate matter and gases like ozone can exacerbate cardiovascular problems and reducing lung function.

2. Water Quality

Poor sanitation and inadequate access to clean water can contribute to

various health issues. Contaminated drinking water can lead to water borne diseases like Cholera, dysentery and lead poisoning.

3. Climate Change

Climate change can result in extreme weather events such as heat waves, floods and hurricanes which can cause direct harm to health. Changes in temperature and precipitation patterns can also affect the spread of infectious diseases and disrupt food and water supplies.

4. Radiation

Ionizing radiation from sources like nuclear accidents or medical wastes can increase the risk of cancer and other genetic mutations disorders.

5. Vector- Borne Diseases

Environmental factors, including temperature and humidity and un hygienic surroundings can influence the distribution and prevalence of vector- borne diseases like malaria, dengue, and Lyme diseases.

Trends in the Level of Pollution

The pollution can be broadly categorized as two types namely (a) Flux type of pollution (b) Sink type of Pollution.Flux type pollution refers to the pollutants dumped into the environment, either to air or in water. Sink type of Pollution is caused by accumulation either in soil or riverbed or also in groundwater.

Air Pollution

The World Health Organization (WHO) defines air pollution as *"substance put into the air by activity of mankind into concentrations sufficient to cause harmful effects to health, property, crop yield or to interfere with property"*. Some of the most important air pollutants factors are

(a) Particulate matter (SPM)

(b) Nitrogen Oxides (NOx)

(c) Carbon Monoxide (CO)

(d) Lead

(e) Sulfur dioxide (SO2)

Major Sources and Health effects of pollutants

Pollutant	Main Source	Health effects
SPM	Ceramic and glass thermal power	Damage of lungs, may cause bronchitis and asthma
SO2	Thermal Power, Chemical, ceramic and textile industries	Acid rain, damage to lungs, eyes skin
NOx	Diesel engines, ceramics	Form smog, damage to respiratory system and eye irritation
CO	Two wheelers, engineering	Toxic causes blood poisoning
HC	Two Wheelers, ceramics chemicals	Cancer
Aldehyde Lead	Chemicals, petrol engines, water pipes, food cans, batteries	Nervous system shows down and brain development is retarded, slow reaction time
Chromium & Nickel	Alloys plating, electronics	Cancer
Mosquitoes, Bacteria, worms and Virus	Stagnant pools & Infected water	Malaria, Jaundice, cholera, dysentery, typhoid, diarrhea

According to the Article 48 of the Constitution of India, the state shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country. The main instruments for control of air and water pollution are the Air (Prevention and Control of Pollution) 1981 and the Environmental (protection Act, 1986) and the executing agencies are implementing the legislation s and policy of the Government on environmental matters.

Water Pollution

Water Pollution comes from three main sources: domestic sewage, industrial effluents and runoff from activities such as agriculture. Water pollution from domestic and human wastewater causes severe water borne diseases (diarrhea, giardiasis, dysentery, typhoid fever, *E.Coli* Infection, and Salmonellosis.) Adverse health effects can include pain in the gastrointestinal, reproductive neurological systems.

Rapid population growth continues to be a matter of concern as it has manifold effects, one of the most important reasons for environmental pollution. With the increasing population, urbanization and industrialization, the transport demand has also increased consequently. Urban pockets are one of the most polluted places in the world, mainly caused by vehicular growth and industrial pollution. Moreover, landfills are to be properly managed to prevent ground water commination. This is now high time for giving top priority to control population and pollution of all types. "What You Give is what you Get".

5.14 Conclusion

The environment that surrounds us has a balance of several composite features. This delicate balance gets disturbed when undesirable products contaminate the environment and causes harmful effects. Urbanisation provides ease of living to its population at the cost of maximum utilization of the available natural resource. Climate change is the major crisis facing planet earth. Several factors cause this crisis and countries all across the globe are fighting against time to reduce the emission ofharmful gases and protect the planet from the harmful effects of global warming. Pollution is yet another serious challenge facing human kind. The human interaction with the environment is the most important cause for such undesirable effects. Thus, it is the responsibility of both as an individual and as a community to help in reducing pollution and protect the environment.

5.15 Let Us Sum Up

Urbanisation is a natural phenomenon that arises due to industrialisation. Due to the rise of unplanned towns and cities, the urban population are subjected to several hardships. Urban planning is the major part of every administration. The people in urban areas enjoy several

facilities which acts as a pull factor leading to large scale migration from rural area. The over utilization of resources in urban areas leads to imbalance in the ecosystem and causes severe forms of environmental degradation. Pollution of air, water and air resources cause health hazards to the urban residents. Urbanisation in India has several unique features and also faces a variety of challenges. Successive governments have introduced schemes for the betterment of urban planning and development. Environmental disturbance also results in serious health hazards and thus need to be addressed immediately. Individual and community wise action is required to make urban settlements safe and better suited for its population and protect the environment at large.

5.16 Self-Assessment

1. Define urbanisation and state its features.
2. List out the challenges that arise due to urbanisation.
3. Analyse the features and limitations of Indian urbanisation
4. Discuss the environmental challenges that arise due to urbanisation in India.
5. What are the causes for climatic change?
6. Explain global warming and its impact.
7. Highlight the various types of pollution and their causes.
8. Analyse the critical issues that are facing the environment.
9. Write the measures to conserve the biodiversity of a region.
10. State the environmental factors that affect the human health.

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