

**MBA/PGDIM First Year**

**Paper - IV**

# **ENVIRONMENTAL MANAGEMENT**



**मध्यप्रदेश भोज (मुक्त) विश्वविद्यालय – भोपाल**

**MADHYA PRADESH BHOJ (OPEN) UNIVERSITY - BHOPAL**

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## Environmental Management

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<b>Unit - II</b> 3. Background to International Efforts for Environmental Protection 4. India's Efforts for Environmental Protection and Public Policy	<b>Unit-2:</b> Global Efforts to Protect Environment (Pages 29-70)
<b>Unit - III</b> 5. Environmental Problems - Global 6. Air Pollution 7. Water Pollution	<b>Unit-3:</b> Pollution (Pages 71-87)
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## INTRODUCTION

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The large-scale exploitation of natural resources has resulted in the depletion of almost all of the available resources. Unchecked population growth and rapid industrialization has accelerated the process of deterioration of natural resources. The world finally woke up to the collective damage done over the centuries, after experiencing drastic climatic change and other related incidents, such as unpredictable rains, earthquakes and floods. Environmental management system helps in conservation of natural resources and protection of habitats.

This book highlights the increasing importance of our environment and the need of educating the people for protecting the environment. Environment, as you know, is the sum of water, air and land and the inter-relationships among them and also with all the living organisms. Natural resources play a vital role in sustaining life on the earth. Natural resources are usually classified into two, namely renewable and non-renewable resources. If one has to understand the environment, one has to first have knowledge about ecology and ecological balance. Biodiversity is the variation of life forms within a given ecosystem, biome or the entire earth. Biodiversity is often used as a measure of the health of biological systems. A study of different types of pollution and their impact on the environment will make you contemplate your future actions in conserving and utilizing the available resources in a prudent manner. This book will make you aware of the various actions taken by the government and non-government organizations and certain international programmes that help to safeguard the environment.

The book, *Environmental Management*, contains five units and is written with the distance learning student in mind. It is presented in a user-friendly format using a clear, lucid language. Each unit contains an Introduction and a list of Objectives to prepare the student for what to expect in the text. At the end of each unit are a Summary and a list of Key Terms, to aid in recollection of concepts learnt. All units contain Self-Assessment Questions and Exercises, and strategically placed Check Your Progress questions so the student can keep track of what has been discussed.

## NOTES





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# UNIT 1 OVERVIEW OF ENVIRONMENT

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## NOTES

### Structure

- 1.0 Introduction
- 1.1 Objectives
- 1.2 Introduction to the Environment
  - 1.2.1 Concept of Determinism
  - 1.2.2 Concept of Possibilism
  - 1.2.3 Neo-Determinism
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## 1.0 INTRODUCTION

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Environment is the composition of external conditions that affect life and development of man and all other living organisms. Mankind is surrounded by natural, socio-cultural as well as psychological environment. Human beings are at the centre of concern for sustainable development. They are entitled to a healthy and productive life in harmony with nature. The branch of biology which studies the interactions among organisms and their environment is known as ecology. It consists of objects of study of interactions of organisms that include biotic and abiotic components of their environment. This field of knowledge helps us understand the various factors which are responsible for the existence of human life on earth, their survival and well-being. Economists and environmentalists now agree that the sustainability of our planet depends on the respect we show to the ecological systems. Ecosystem includes both living and the non-living components and their interactions. There are two most common types of ecosystem: natural ecosystems and artificial ecosystems. However, the dynamic interactions within an ecosystem are numerous and complex.

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## 1.1 OBJECTIVES

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After going through this unit, you will be able to:

- Discuss the concept of environment
- Explain the concept of determinism, possibilism and neo-determinism
- Understand the meaning and nature of ecology

## NOTES

- Discuss ecosystems and its various types
- Examine various ecosystem resources
- Analyse human-ecosystem interactions
- Evaluate ecological balance and its relationship with ecosystem

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## 1.2 INTRODUCTION TO THE ENVIRONMENT

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Environment is the life support system on which the existence and perpetuation of all living organisms depend. The present day environment can be considered to have physical, chemical, biological, scientific and technological components in which the organisms remain embedded. The whole environment is composed of three complexes.

- Abiotic
- Biotic
- Scientific and technological

All the three sub-complexes interacting with each other constitute the total environment. The environment today is subjected to large-scale transformations in various abiotic and biotic components. The third sub complex has witnessed massive changes occurring due to scientific and technological revolutions that have taken place during the past century. Haber (1989) has called this artificial environment as ‘techno-ecosystems’.

### Definitions of Environment

- According to Misra (1962), ‘The organism is supposed to remain embedded in a matrix called environment.’
- ‘Aggregate of all conditions affecting the existence, growth and welfare of an organism or group of organisms.’— Webster’s concise dictionary
- ‘A Person’s environment consists of the sum total of the stimulations which he receives from his conception until his death.’ — Boring.
- ‘The environment is everything that affects the individual except his genes.’ — Anne Anastasi.
- ‘The term environment is used to describe in the aggregate all the external forces, influences and conditions which affect the life, nature, behavior and the growth, development and maturity of living organisms.’ — Douglass and Holland.

Viewing all the definitions, it is very easy to answer the question—What is environment?

- Sum total of stimulations an individual receives up to death
- External forces, influences and conditions
- Inseparable whole which is constituted by the interacting systems of physical, biological and cultural elements

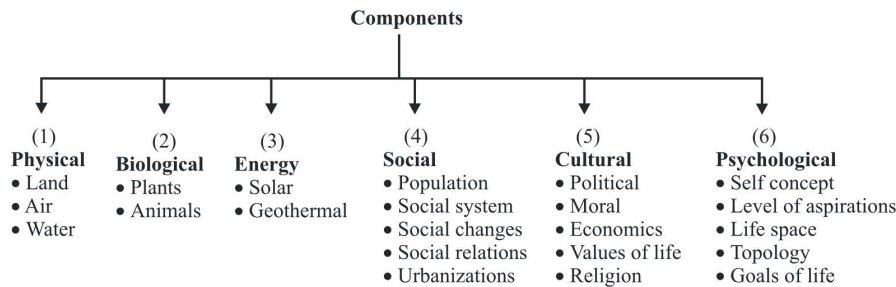
- Surroundings of an organism which includes both living and non-living components
- Holocoenotic concept of environment propounded by Allee and Park (1939) that all the components of environment act collectively and concurrently
- The parameters of environment are interwoven with each other constituting a spider web like structure. — Cain (1944), Billing (1952, 1964)

**NOTES**

These parameters are

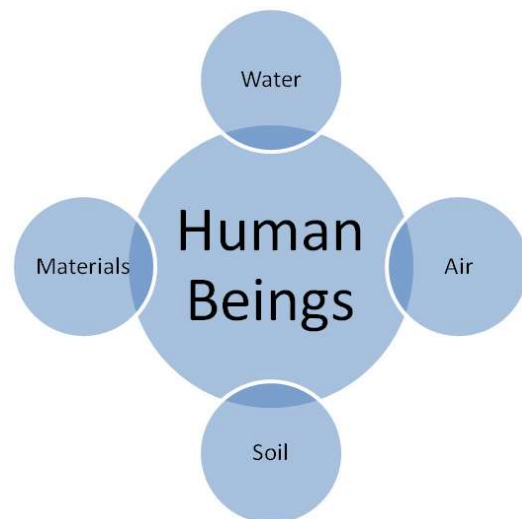
- Earth, Water, Energy, Space, Air, Food, Fodder, Fuel, Fiber, Hand pollution, Water pollution, Air pollution, Nuclear emissions.

The environment is broadly classified into the following components:



**Concept and Meaning of Environment**

Environment has been derived from the French word ‘Environ’ which implies ‘to encircle or surround.’ All living and non-living things surrounding us comprise the environment. According to the Environment (Protection) Act 1986, ‘environment’ includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property. The concept of environment can be shown as follows:



*Fig. 1.1 The Concept of Environment*

Figure 1.1 represents the elements, that is, air, water and land which surround human beings. These elements comprise the environment and hence have a direct

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influence on human beings. Simultaneously, human beings also influence the environment either through exploitation of natural resources or by polluting the environment. Plants, animals, micro-organisms and the structures made by man in our surroundings have a direct and indirect influence on us. The entirety of all these elements and their interactions make up the environment.

Urban environment is to some extent different from rural environment. Human beings deeply influence the urban environment. Several natural landscapes in cities have been modified or altered and replaced by man-made structures like commercial complexes, factories and transportation networks. Air, water and soil of the urban environment are completely filled with several kinds of chemicals and wastes. The range of plants and animals present in the urban environment is far less as compared to the rural environment. Also, population is dense in the urban areas as compared to the rural environment.

### 1.2.1 Concept of Determinism

Determinism is a concept which conveys several characteristic features which are found to define a society or an individual. Human beings are controlled by the environment, and the technologies which they use. Therefore, in a given situation they present a definite behavioural pattern.

‘Determinism is a metaphysical philosophical position stating that for everything that happens there are conditions such that, given those conditions, nothing else could happen. There is much determinism, depending upon what pre-conditions are considered to be determinative of an event.’

‘It is not possible for a human being to do anything different from what he actually wants. In actual case, the circumstances decide the actions of an individual.’

Human beings are a part of the environment and thus, have to follow the rules of nature and the laws of science. If we feel that whatever one does is already decided then there is no blame on the events that take place. In this respect, determinism is found to be true.

The concept of determinism is a complex phenomenon. It states that whatever things are found in nature depends on their present status or conditions and the facts how things are affected by the natural laws. When position and status of the biotic agents and functioning of natural laws is understood we can easily interpret the laws of nature and science.

The hypothetical views of theory of physics explain the presence of small particles in the universe and their interactions. The present theory helps in defining the different aspects involved in determinism. The three aspects are:

1. The present status and position of things.
2. How the things follow natural laws.
3. Response of things against the applied laws.

Determinism provides-

- What conditions would be found in future estimating the status of universe.
- As determinism is a metaphysical concept, the future conditions will be existing and must be followed by natural laws.

Determinism is defined in some other ways as well:

- The event and reactions that take place have a certain cause. Without definite cause nothing is possible.
- The facts related with the effect of natural laws on the present situations explain the future pattern of things.

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**Views on Quantum Theory**

- Quantum physics generally believes that determinism is false.
- Human actions are decided by quantum actions as it affects human responses.
- The future conditions can be predicted in advance if a person has sufficient computational powers.
- The freedom of one’s actions can be compared with determinism.
- Determinism is not a philosophical issue rather it is an issue settled by physics.

Any theory which is not accepting the views that every event takes place is earlier decided by some causal factors cannot be a part of determinism. Many forms of determinism are defined. Some can be tested with the help of physics and philosophy of physics.

Determinism is often contrasted and confused with the following terms:

**1. Free will:** The different positions related to free will and determinism are shown below:

	<b>determinism is true</b>	<b>determinism is false</b>
Free will is compatible with determinism (i.e. compatibilism is true)	Soft determinism	[no name]
Free will is not compatible with determinism (i.e. incompatibilism is true)	Hard determinism	Libertarianism

**2. Compatibilism:** Free will can be compared with determinism. The other views state that determinism cannot be compared with free will. Some are of the opinion that when any event is held by determinism, free will cannot exist. On the other hand, when an event is held with free will, determinism cannot exist. Free will never considers any cause, conditions and any other determinants of behaviour.

		Free Will	
		'Free Will' is Impossible	'Free Will' is Possible
Determinism	Physical Determinism is True	Hard Determinism	Compatibilism
	Physical Determinism is False	Hard Incompatibilism	Libertarianism

## NOTES

- 3. Materialism:** The term materialism explains the interaction between non-biotic things only; therefore, it cannot be compared with determinism as determinism explains the reaction of biotic and non-biotic agents by using mind and soul.

### Types of Determinism

The different types of determinism are as follows:

- 1. Causal determinism:** As the name suggest, it explains the law of cause and effect. Whenever there is a cause there will be an action and action will produce an effect as a response to it. The present status of the environment changes with causes bonded to it. It explains (a) The changes that place in the universe and have a long sequence which attracts our attention to their past or their origin. (b) The events are caused by some specific causes and not by their own self causal factors.
- 2. Historical determinism:** As causal determinism explains the causes of events from their origin, the historical determinism adds that everything that happens is caused by antecedent conditions.
- 3. Nomological determinism:** This type of determinism is a combination of past status of universe and the natural laws which decides the events of future. This form of determinism suggests that the past and present events combine to design the future by obeying the natural laws.

The terms scientific determinism and physical determinism are synonymously used with nomological determinism.

- 4. Necessitarianism:** It is a metaphysical concept which infers that every event takes place with certain causes and whatever happens has a cause and reason.
- 5. Predeterminism:** This concept helps in understanding that an event which takes place is already decided in advance. There is a long sequence of occurrence which stretches the ideas back to the origin of universe which is already established. Human activities cannot check and disturb the responses of these sequences. It can be compared with causal determinism and biological determinism as it explains about the existence of future status caused by specific causes.
- 6. Fatalism:** This type of determinism believes in the destiny of an individual. It explains that whatever events take place in an individual's life depend on his/her fate and human actions cannot control it.
- 7. Theological determinism:** It is a form of determinism which refers to the occurrence of events by pre-decided patterns and the presence of destiny. There are two types of theological determinism namely: strong and weak theological determinism.
  - **Strong theological determinism:** Favours the occurrence of events by the dominance of super powers or the powers of God.
  - **Weak theological determinism:** Explains that whatever happens is already known to God and future is fixed.

8. **Logical determinism:** Logical determinism explains that whatever the idea formed behind the present, past and future will be either true or false. Some theories make attempts to explain the interaction between nature and creature which can be predicted.
9. **Biological determinism:** Biological determinism believes that behaviour, belief and desires depend on genetic characteristics of human beings. The behaviour of a human being is framed according to environmental reflexes that one gets.
10. **Environmental determinism:** This type of determinism is also known as climatic or geographical determinism. According to this form of determinism, the physical and social conditions of environment design, and the culture patterns decides the behaviour of an individuals. The formation of behaviour is dependent upon the stimulus response theory. Human beings act or show their response according to the type of stimulations they absorb. The climatic conditions mould the psychological setting of mind and human beings behave accordingly. Sometimes, humans migrate from one geographical location to another for survival.
11. **Cultural determinism:** Man is a social creature. Cultural determinism means that a human being is identified by the culture in which he/she lives. It is a nurture focused theory.
12. **Psychological determinism:** It is a concept which refers to the psychology of human mind. Humans act according to their requirement, need and interest and interact with their surroundings.
13. **Linguistic determinism:** Language is the mirror of mind. Whatever a human being thinks and understands, he/she expresses through language.
14. **Economic determinism:** It explains the role of economy and political features in the development of human beings. The political conditions affect the economic structure of a country.
15. **Technological determinism:** The social structure and cultural values are developing in a society through the application of technology.
16. **Media determinism:** This kind of determinism explains the role of media in a particular society. The philosophical and sociological set up of a society is influenced by media.
17. **Mathematical determinism:** This determinism accepts the concept of chance. The things that will happen in future show probability to occur or not. The probability can be confirmed only by the past experiences and the previous results.

### Factors Influencing Determinism

Some of the factors influencing determinism are:

#### 1. Interrelationship among individuals

- Mutual dependency and cooperation among individuals
- Affection and attachments among individuals

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## NOTES

- Interaction between the individual and nature
- Biotic and non-biotic agents build the environment
- Actions and responses are the bases of determinism

### 2. Grouping

When an affectionate bonding is developed among individuals, a group is formed. For example, family is a group. Families unite together to form a social group, ultimately, becoming a society.

### 3. Continuous existence

Existence of an individual is dependent on the favourable conditions and circumstances. The favourable conditions are the presence of air, water, food, clothing, earth, fire and shelter for survival.

### 4. Likings or disliking

The group of individuals is classified and identified by their liking and disliking between the groups and among the individuals. The sex, age, language, family, race, regions, religions, wealth, politics, occupation, health, physique, looks, temperament, interest and abilities are the factors that cause classification.

### 5. Infirmity and mortality

Darwin's theory states 'Survival of the fittest.' Individuals in a biotic world are always at a risk of survival.

- Injuries, defects, diseases can cause death
- Genetic defects at the time of development
- Exposure to dangerous things

These are the three risks of survival.

### 6. Coping Strategies

The strategies by which humans cope with their environment are: adhibition, inhibition and explication.

- **Adhibition:** It means the actions, responses which are taken in use or the human remains engaged with them. These responses are used to control the situation and get perfection to fulfill the requirement.

#### **Adhibitory strategies:**

- o Perseveration
  - o Orderliness
  - o Constant exertion
  - o Risk of exploitation
  - o Displacement
  - o Addiction
- **Inhibition:** In contrast, inhibition means avoiding the present situation. Its strategies are fixation, regression, phobia, sleeping spells, depression, suicide, mutilation of body parts.



- **Explication:** It implies getting knowledge about the experiences, situations, signals or stimulations obtained from the environment. This type of coping strategies comprises construction, inferences, conceptualization, formulation, designing, and evaluation to get knowledge about what should take place in the environment.

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### 1.2.2 Concept of Possibilism

Possibilism is a theory of geographical culture that explains that environment has certain limitations. Its culture is defined by the actions of human beings. According to Marshall Sahlins, 'Possibilism is an alternate concept of environmental determinism.'

According to Mackinder and Kropotkin, 'Possibilism in geography is, thus, considered as a distinct approach to geographical knowledge directly opposed to geographical determinism.'

Possibilism explains the relationship between the human and physical environment. Humans have a specific ability to adjust with the environment by modifying their responses. They react to the changes in environment according to the stimulus they receive from it. It is directly matched with the concept of environmental determinism which is in favour of the fact that the environment is responsible for shaping, limiting and controlling the development of culture.

The main emphasis is given to:

- The relationship between people and their surroundings.
- People are free to decide their own direction in which they can adapt to different lifestyles.
- According to this concept, environment does not decide the actions, nature and behaviour of individuals rather it provides opportunities to human beings to shape themselves.
- People are adaptive in nature. They adapt themselves in different places and in different habitat on earth.

The French historian Lucien Fabvre explained the concept of possibilism by saying that, 'When possibilism relates with human behaviour to their environment, there are no necessities but everywhere possibilities.'

Possibilism lays emphasis on thoughts, actions and ability to cope with environment and control one's own destiny.

#### Main Conclusions

- Possibilism does not accept the influence of environmental factors in human life.
- Environment does not play any role in the development of culture.
- It provides choices to human beings to adapt and show their responses.
- Man is the main partner of the environment and he moulds his surroundings according to his needs.

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- Man makes many changes and modifications in environmental conditions according to his needs to fulfil his demands.
- A physical environment provides opportunity to human beings to act.
- The physical and social environment creates many chances and possibilities for human beings to choose freely and respond.
- Possibilism is a philosophy which explains the relationship between man and environment.
- The concept of possibilism accepts man as an active agent of environment.
- It asserts that the natural environment provides many options as knowledge and technology of cultural group increases.
- There are three reasons:
  - (a) Industrial revolution
  - (b) Agricultural Advancement
  - (c) Technological revolution

### **Industrial Revolution**

Increased demand for basic necessities due to rapid growth of population in India led to the Industrial Revolution. Industrial Revolution started way back in 1960s when India was struggling from the problems of poverty, unemployment and over population. The emergence of newer technologies helped India to become a self-reliant state.

Though it was a remarkable achievement for the Indian economy, it also gave birth to various environmental concerns like pollution, global warming, urbanization, deforestation, creation of slums and deteriorated living conditions.

### **Agricultural Advancement**

India is an agricultural country. With the advent of 1947, the Indian economy was hugely dependent on the agriculture sector. With 70 per cent of national income obtained from this sector, agriculture also witnessed a lot of advancement since its onset. To fulfill the increasing demands of food, the use of fertilizers and pesticides, modern irrigation methods, green revolution and organic farming methods have been adopted by the Indian farmers so as to increase the yield of crops.

No doubt, there is a great increase in the productivity; simultaneously it is inversely affecting the environment. Acid rains, soil erosion, adulteration, soil degradation, disturbance in monsoon cycle affect the growth of agriculture.

### **Technological Revolution**

The world has witnessed drastic changes in the past few years; the lifestyle of people has been affected greatly. Due to the emergence of new technologies, the modern societies are thriving to get the edge of the newest up gradation.

Today the use of computers, television, internet and modern means of transport has reduced the distance across the globe but it has widened the gap

among human beings. Not only the physical environment but also the social and the psychological environment is getting affected.

### 1.2.3 Neo-Determinism

Taylor, in 1920s put forward the concept of neo-determinism. He believed that agricultural production mostly depended on the physical environment. As agriculture is affected by physical nature of environment the economy of the country is also affected. The producers of agricultural products are the main agents who play an important role in the economic progress of the country.

Man is the main source of development who is capable of bringing about significant changes in a country's development by changing the rate and direction of progress.

Environment offers several opportunities to man to select his actions either wisely or foolishly. He therefore has the wisdom to not take actions which will act against the environment.

Nature has two phenomena in common 'possible and impossible.'

Environment does not provide equal chances to everyone. Sometimes, very little amount of possibilities of actions are found; sometimes harsh struggles resulting in more or less amount of production.

Nature never decides and never gives any clue to human beings to show its preferences of actions. It is not clear which action will be accepted by the nature.

The concept of determinism accepts that man is not a free agent of nature and he has no freedom to decide his actions. On the other hand, the concept of neo-determinism agrees that man is a free agent of nature, he is free to choose his actions, he is free to take decisions and free to select alternative actions.

He has limitless possibilities out of which he selects his best actions. His actions are determined wisely to achieve the goals.

When we compare determinism, possibilism and neo-determinism, we reach to the conclusion that:

- **Determinism** is the concept which explains that nature affects the physical, mental and moral mind sets and habits of mankind and determines the culture and behaviour of the individuals and the society. Further, it suggests that whatever the actions, the actions of the individuals are already predetermined.
- **Possibilism** is that concept which suggests that man decides his actions according to the possibilities he finds from the environment. His actions determine the culture. He has limitless possibilities out of which he can select according to his needs and demands.
- On the other hand, neo-determinism believes that environment provides many chances to man out of which he has to select his actions by using his wisdom. The opportunities are not equal for all but only wise people can select the best actions to reach their goals.

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**Check Your Progress**

1. Define nomological determinism.
2. What is Fatalism?
3. List the factors affecting determinism.
4. What does possibilism emphasise on?
5. What do you understand by the concept of neo-determinism?

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### **1.3 REALM OF ECOLOGY**

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The branch of biology which studies the interactions among organisms and their environment is known as ecology. It consists of objects of study of interactions of organisms that include biotic and abiotic components of their environment. This field of knowledge helps us understand the various factors which are responsible for the existence of human life on earth, their survival and well-being. Economists and environmentalists now agree that the sustainability of our planet depends on the respect we show to the ecological systems. Ecosystem includes both living and the non-living components and their interactions. There are two most commonly types of ecosystem: natural ecosystems and artificial ecosystems. However, the dynamic interactions within an ecosystem are numerous and complex.

This unit offers an in-depth and analytical approach to interrelationship between ecology and ecosystem.

#### **Ecology and Ecosystem: Meaning, Nature and Relationship**

An organism is a form of life. A wide range and variety of organisms are present on earth from the single-celled amoeba to huge sharks, from microscopic blue-green algae to massive banyan trees. It includes all plants and animals which can be clubbed in various ways under different categories. These are:

##### **(i) Species**

Group of organisms that resemble one another in appearance, behaviour, chemistry and genetic structure form a species. Organisms of the same species can breed with one another and produce fertile offspring under natural conditions. For instance, all human beings (*Homo sapiens*) resemble one another in their body structure, body systems and they all have similar genetic structure. They are thus grouped together under the species and sapiens.

##### **(ii) Population**

Population is a group of individuals of the same species occupying a given area at a given time. For example, the Asiatic lions in the Gir National Park, Gujarat, make a population. Group of individual organisms of the same species living within an area is called population.

**(iii) Communities**

Groups of various species occupying a particular area and interacting with each other make up a community. For instance, when we say ‘the community of the Gir National Park’, we refer to the lion population, the deer population, the cattle population, the grass population and populations of all kinds of life forms present there. Thus, community comprises several species interacting with each other.

Any assemblage of populations living in a prescribed area or physical habitat that has characteristics in addition to its individual and population components can be called a community.

**(iv) Cycles**

The circulation of the chemical elements in the biosphere, from the environment to organisms and back to the environment, is called cycle.

**(v) Food Chain**

The transfer of food energy from its source in plants through a series of organisms where eating and being eaten is repeated a number of times is called food chain.

**(vi) Carrying Capacity**

The maximum population of a particular species that a given habitat can support over a given period of time is known as the carrying capacity of the habitat.

**1.3.1 Ecosystem**

An ecosystem is a community of organisms involved in a dynamic network of biological, chemical and physical interactions between themselves and with the non-living components. Such interactions sustain the system and allow it to respond to changing conditions. Thus, an ecosystem includes the communities, the non-living components and their interactions. The Gir ecosystem will thus include the various life forms found in the park (the community) and also the non-living components of the park like the soil, rocks and water and even the solar energy that is captured by the plants.

The sum total of all the ecosystems on planet Earth is called the biosphere, which includes all living organisms on earth, interacting with the physical environment as a whole, to maintain a steady-state ecosystem.

The community of organisms and populations that are interacting with one another and with the chemical and physical components of their environment is called ‘ecosystem’.

The term ecosystem was first proposed by A.G. Tansley (1935) who defined ecosystem as follows: ‘Ecosystem is defined as a self-sustained community of plants and animals existing in its own environment.’

Odum (1971) defined ecosystem as any unit that includes all the organisms in a given area interacting with the physical environment, so that a flow of energy gives rise to a clearly defined tropic structure, biotic diversity and material cycles within the system.

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Michael Allaby (1983) defined ecosystem as a community of interdependent organisms together with the environment.

The term ecosystem is made up of two words: eco and system. Eco means ecological sphere or a region of space where living things can exist, while system mean interacting organisms living in a particular habitat (living space). Thus, the system resulting from the integration of all the living and non-living factors is called ecosystem.

An ecosystem may be defined as a dynamic entity composed of a biological community and its associated abiotic environment. Often, the dynamic interactions that occur within an ecosystem are numerous and complex. Ecosystems are always undergoing alterations in their biotic and abiotic components. Some of these alterations first begin with a change in the state of one component of the ecosystem, which then cascades and sometimes, amplifies into other components because of relationships.

### Types of System and Ecosystem

Thermodynamically, a system is any part of the universe separated from the rest by a well-defined boundary. Likewise, a living organism has a boundary, the skin.

Thermodynamically, systems can be of three types:

- **Isolated system:** There is neither an exchange of energy nor matter with the environment.
- **Closed system:** There is an exchange of energy but not matter.
- **Open system:** There is an exchange of both energy and matter.

Open systems are not in thermodynamic equilibrium but in a dynamic steady state. Living systems are considered to be open.

In case of an ecosystem, the boundary is not rigidly defined. The ecological system or ecosystem is defined as a system where the biotic community (living organisms) and the non-biotic (non-living organisms) environment function together as one complete unit. Thus, an ecosystem includes both the living organisms and their non-living counterparts, the environment, each influencing the characteristics of the other and both are necessary for the survival and maintenance of life. An ecosystem has both structure and function. The structure tells about the diversity of species, as function involves the flow of energy and cycling of materials through the structural components. The earth as a whole, is thus a vast ecosystem and the portion of the earth in which the biotic components, i.e., the living matters are present is called 'biosphere' or 'ecosphere'. Relative to the volume of the earth, the biosphere is only a very thin surface layer that extends from 11,000 metres below sea level to 15,000 metres above.

Ecosystem is of two types:

- (1) Natural ecosystems
- (2) Artificial ecosystems.

**1. Natural ecosystems:** Ecosystems like ponds, lakes, oceans, forests, grasslands and deserts, which are self-regulating systems, without much direct human interferences or manipulations are called natural ecosystems.

The natural ecosystem is thus, of two types: (a) terrestrial ecosystem (land based ecosystem) (b) aquatic ecosystem (water-based ecosystem).

2. **Artificial ecosystems:** The town, city and agricultural ecosystems are man-made ecosystems and are therefore, called artificial ecosystems.

### **Ecosystem Resources**

For many years, Indian villagers have been dependent on forests for fuel-wood to cook food. Deforestation was not immense when the population was less. However, with growing needs of the ever-increasing population, the situation has changed over the last few decades. Forests and the animals they sheltered have disappeared. The disruption of this ecosystem has negatively affected the social system. Increase in the human population, deforestation, fuel shortage, decreased food production have adversely affected our ecosystem. Several human activities have impacted the ecosystems and its components in a way that achieving sustainability has become a distant reality.

Development is conventionally reconciled with the economists' view of maximizing wealth for better quality of life for the people. The notion of economic development was challenged when the ill effects of overexploitation surfaced and paved way for sustainable development as a cherished goal that rests on mutually reinforcing relationship between ecology, economic development and social justice. Sustainable development can be defined as meeting present needs without compromising the ability of future generations to meet their needs. It is about leaving a cleaner earth for the future generations. Ecologically sustainable development is about keeping ecosystems healthy. It is about interacting with ecosystems in ways that allow them to maintain sufficient functional integrity to continue providing humans and all other creatures in the ecosystem the food, water, shelter and other resources that they need.

The sustainability of our planet depends on the respect we show to the ecological systems. On this rests the well-being of all organisms including the human race. Of late, ecosystems have been affected by climate change; large-scale shifts in the ranges of species; timing of the seasons and animal migration; deeply stressed coastal areas; threat to certain important benefits provided by ecosystems and frequency and aggressiveness of disasters like tsunami. Natural ecosystems benefit humans by providing clean drinking water, and processes that help decompose dead plants and animals.

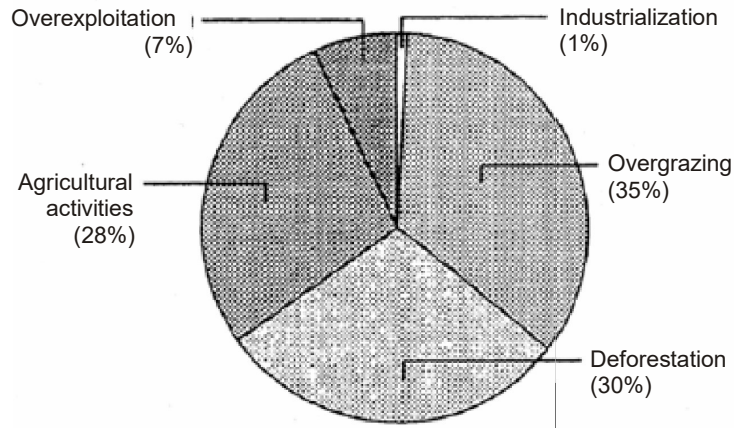
### **1. Land**

The delineable part of the earth not covered by water is known as land. Land resources provide various functions or services including provisioning, regulating and supporting. However, the quality of the services reached its threshold as communities started exploiting land resources in the name of meeting their own needs. It is important to note that the renewal of land resources is a slow process. The rate of degradation of land is much faster than the natural rate of generation. This means that land that is lost due to degradation will not be naturally replaced within a human time frame. This will lead to a loss of opportunities for the future generations. Deforestation, farming, damming of rivers, industrialization, mining, urbanization, etc., have seriously stressed land resources.

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Recent studies conducted worldwide show that land resources have been overexploited by man. The traditional land resource management is no longer appropriate and technology is not always available or affordable. Figure 1.2 provides a snapshot of the causes of land resource degradation of the world.

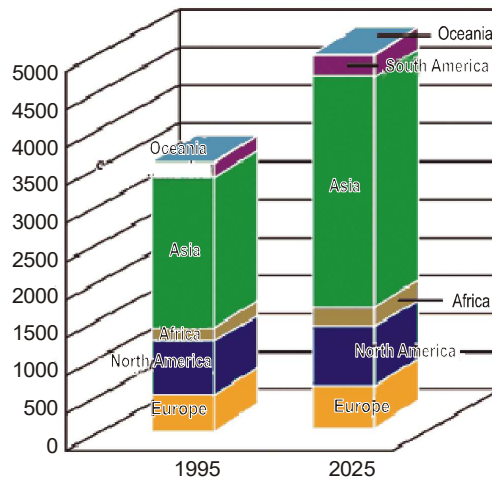


**Fig. 1.2** Causes of Land Resource Degradation

Degradation of land resources has resulted in serious variance in the energy balance. The aftermath of this has been made evident through the erratic change in the climate patterns and has posed an alarming threat of food insecurity for the growing population. The need of the hour is to promote the role of ecosystem facilitators rather than exploiters, charged with the responsibility of safeguarding the rights of unborn generations and of conserving land as the basis of the global ecosystem.

**2. Water**

After air, no other ecosystem resource holds greater significance than water. Water is a fundamental resource for development and is vital for the survival, health and dignity of human population. About 97.5 per cent of global water resource is saline in nature and found in the seas and oceans. The other 2.5 per cent of water resources provide fresh water to support 86 per cent of the world’s population through glaciers, groundwater, permafrost and surface and atmospheric water. Figure 1.3 provides a comparison of worldwide water resource availability over a range of thirty years.



**Fig. 1.3** Comparison of Water Resources Available Over a Range of 30 Years



The freshwater reserves throughout the world are rapidly declining. An estimated 3 billion people will be living in water poverty by 2025. Urbanization, overpopulation and wastage of groundwater, contribute towards an increase in per capita domestic consumption. As a result, India, China, Africa and Europe will face acute shortage of freshwater by 2025. India will face acute scarcity of water by 2050.

Sustainability of water resources in India is fast becoming a necessity. The increasing population and the high rate of development have led to an increase in pollution, over-exploitation and degradation of the environment. Weak government policies and economic incentives have led to inappropriate use of water resources in the last few years. Management of water resources should be carried out using a holistic approach that addresses the pressures arising from various sources such as the agricultural, industrial and domestic sectors.

### 3. Air

Understanding the relationship between air pollution and ecosystem services is vital for achieving sustainable development of the communities. Air is a precious resource that supplies us with oxygen, which is essential for us. Air quality primarily influences the atmosphere in which people live and breathe.

Several researches conducted globally on air pollution suggest that developing nations are the most affected by it. Air pollutants such as nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>3</sub>) and sulphur dioxide (SO<sub>2</sub>) have major effect on the ecosystem services. These range from substantial reductions in food provisioning due to crop yield impacts (O<sub>3</sub>) to changes in the ecosystem functioning. It is likely that these impacts represent a barrier to providing sufficient crop growth to reduce hunger and maintaining diverse natural ecosystems.

### 4. Energy

Understanding the links between energy, poverty and ecosystem services is important for attaining sustainable development. Increased access to energy for the poorest part of the world's population will help in holistic, sustainable development. The current energy use of the poor is neither sufficient to attain the sustainable development nor is it sustainable in terms of maintaining important ecosystem services that can facilitate a transition out of poverty. Meeting the basic energy needs of the poor with minimized impacts on the ecosystem services needed for other aspects of sustainable development attainment such as food production and livelihood support is thus vital.

### Other Resources

Another important ecosystem resource which is important to discuss in the present scenario is biodiversity. Biodiversity provides both tangible and intangible benefits like food, fodder, fibre, fuel, climate regulation, flood and drought control, nutrient recycling, cultural and recreational benefits.

Development processes like industrialization and urbanization have brought about loss and degradation of biodiversity throughout the world. Today, several species of organisms, plants and animals are at the threshold of extinction and their

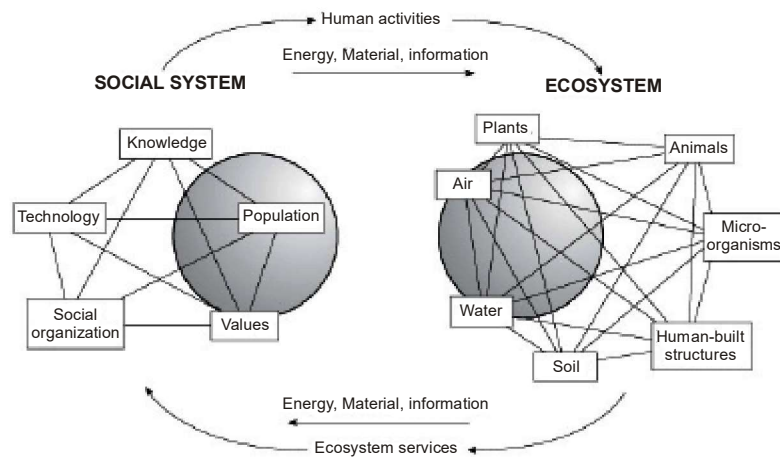
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conservation is the need of the hour. Identifying the importance of biodiversity, attempts are being made through following various approaches and different strategies, to conserve it. One of the prominent organizations in this area is International Union for Conservation of Nature (IUCN) which has been doing remarkable work in conservation of endangered species.

**1.3.2 Human–Ecosystem Interactions**

Ecosystems are strongly affected by human activities which are a simple manifestation of society where human beings live. In a simple human-ecosystem interaction, the ecosystem provides services to the human social system by the way of moving materials, energy and information to meet people’s needs. The ecosystem resources, both natural and artificial, play a very vital role in the discharge of ecosystem services of provisioning, regulating, supporting and recreating. Like ecosystems, human social system affects the ecosystem through use of ecosystem resources for their survival needs. This relationship has been displayed in Figure 1.4.



*Fig. 1.4 Human Ecosystem Interaction*

**Source:** <http://www.gerrymarten.com/human-ecology/images/01-1-english.jpg>

Human-ecosystem interaction may be explained through the concepts of common property resources, coexistence and adaptive development.

**i. Common Property Resources**

Common Property Resources (CPR) include all such resources which are meant for common use of the villagers but not for individual possession. These resources are an indispensable aspect of the social and institutional arrangements made to meet the everyday requirements of village communities. They are particularly important to the landless, the agricultural labours and rural artisans. Usually, common property resources are identified by three factors—access, common use and communal purpose. These two characteristics distinguish it from a private good, which is subject to exclusive use and possession by individuals. These resources are community pastures and forests, wastelands, common dumping and threshing grounds, watershed drainages, village ponds, rivers and other common pool water bodies.

CPRs perform a major role as a life support system. In developing countries like India, CPRs are an important component of the resource base of both the rural as well as urban communities. They contribute to the production and consumption needs of the people in these communities, as well as beyond. When properly managed, CPRs ensure the sustainability of agro-ecological systems providing basic needs and sustenance for the poor.

Nearly everywhere, common property resources have been steadily reduced in extent and importance in modern times. Activities like encroachment as well as privatization and government appropriation are the main processes that have taken resources out of communal control. Increasing pressures on what is left have generally led to its progressive degradation, encouraging further expropriation. The need of the hour is, therefore, bring in a more successful common property resources management that has:

- Social groups with rights to a clearly defined resource.
- Ability to exclude others from using the resource.
- Set of use rules that limit the seasonality, extent, or ways in which the resource is extracted by individuals.
- Capacity to monitor use and enforce rules.

## ii. Coexistence

Coexistence is a common architectural feature of ecosystems where autotrophs and heterotrophs exist together in a mutually interdependent, compulsory relationship that ensures the flow of energy and the constant recycling of vital chemical nutrients through the ecosystem. Constant energy and nutrient flows are important if the system has to carry on as a self-sustaining collection of components and relationships within a certain physical environment.

Coexistence in relation to human–ecosystem interaction could be used to explain the respectful and non-violent relationship between human beings and different species living in a given place at any given time. The example that follows is that of coexistence of urban ecosystem in chaparral of southern California.

## iii. Adaptive Development

Understanding the concept of adaptive development paves way for understanding the notion of resilience and its relationship with sustainable development.

The capability of an ecosystem to endure disturbances like storms, fire and pollution, without changing its form, is known as ecosystem resilience. If a resilient ecosystem is damaged, it has the ability to repair itself. In a resilient ecosystem, the procedure of repairing facilitates renewal and innovation. Without resilience, ecosystems become more prone to the effects of disturbances, which could have previously been absorbed.

Clean and clear lakes can turn into dirty, oxygen-depleted pools; grasslands can be converted into shrub-deserts, and coral reefs into algae-covered rubble. All these are a result of a combination of disturbance patterns caused by human alteration in nature, and due to reduced social and ecological resilience of ecosystems. Coral reefs, mangrove forests and other coastal wetlands shelter human

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settlements from coastal storms. Forests and wetlands help in absorbing floodwaters. Sadly, our activities have depleted resilience in many natural systems to such an extent that their ability to protect us from disturbances has declined. Furthermore, the resilience of many social systems to natural calamities has been decreased as the increase in the human population growth has forced people to settle down and conduct economic activities in vulnerable areas.

### **1.3.3 Ecological Balance and its Relationship with Ecosystem**

Ecological balance or ecosystem stability implies a balance between the production and consumption of each component in the ecosystem.

According to T.D. Brock, 'Steady state condition in nature ecosystem is a time independent condition in which production and consumption of each constituent in the system is exactly balanced, the concentration of all constituents within the system remains constant, even though there occurs a continual change'.

There are a number of theories, mechanisms and models to explain the stability of ecosystem. The important ones are as follows:

#### **(i) Theory of Diversity or Stability**

If there is diversity of food webs, it will lead to an increase in the number of links in the food web and if community succession operates in an ecosystem, the stability will increase.

#### **(ii) Homeostatic Mechanism**

Inbuilt, self-regulating mechanism is known as homeostatic mechanism. If within an ecosystem the population of a species increases significantly, the result will be scarcity of food, leading to competition for food. Most species will die of starvation and the species population will be brought back to its original value and the stability will be restored.

#### **(iii) Models**

The equilibrium as well as non-equilibrium model can explain stability. Thus, if the ecosystem is disturbed by external factors, it may quickly return to its original state by some adjustments, restoring the stability. However, if it does not return to its original state, the disordered arrangement might lead to cross-relationships and make the system stable.

#### **Ecological Instability**

When an ecosystem is unable to adjust to the environmental changes, it is said to be unstable. The instability occurs due to a number of natural and anthropogenic activities such as destruction of natural vegetation and animal species, partly or completely or by replacing them by other vegetation and animals, introduction of toxic substances like insecticides and pesticides and toxic gases like SO<sub>2</sub> and NO<sub>2</sub>.

### 1.3.4 Importance of Ecology

During the past decades, due to rapid increase in technology and population, humans have far more influenced their own environment than any other ecosystem.

Some quoted examples of ecological crisis are as follows:

- *Permian*: Triassic extinction over 25 million years ago.
- *Cretaceous*: Tertiary extinction over 65 million years ago.
- Global warming related to greenhouse effect could involve flooding of the Asian deltas, multiplication of extreme weather phenomena and changes in the nature and quality of the food resources.
- Issue with the hole in Ozone layer
- Deforestation and desertification, resulting in disappearance of many species.
- The nuclear meltdown at Chernobyl in 1986, caused the death of many people and animals due to cancer and caused mutation in large number of people and animals.

The study of ecology helps us to understand the various primitive factors responsible for the existence of life on earth. The survival and well-being depend entirely on the ecological relationships. Although, ecology is considered a branch of biology, it deals with many other branches of science, such as chemistry, physics, geology, geography, meteorology, pedology, etc. Thus, the study of ecology gives a reactive insight into the universe and helps to take proper care of the environment for overall survival.

#### Check Your Progress

6. Define ecology.
7. What is an ecosystem?
8. What are Common Property Resources (CPR)?

## 1.4 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Nomological determinism is a combination of past status of universe and the natural laws which decides the events of future. This form of determinism suggests that the past and present events combine to design the future by obeying the natural laws.
2. Fatalism believes in the destiny of an individual. It explains that whatever events take place in an individual's life depend on his fate and human actions cannot control it.
3. Some of the factors affecting determinism are:
  - Interrelationship among individuals
  - Grouping

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- Continuous existence
  - Likings or disliking
  - Infirmity and mortality
  - Coping Strategies
4. Possibilism lays emphasis on thoughts, actions and ability to cope with environment and control their own destiny.
  5. Taylor, in 1920s put forward the concept of neo-determinism. He believed that agricultural production mostly depended on the physical environment. As agricultural is affected by physical nature of environment the economy of the country is also affected. The producers of agricultural products are the main agents who play an important role in the economical progress of the country.
  6. The branch of biology which studies the interactions among organisms and their environment is known as ecology.
  7. An ecosystem is a community of organisms involved in a dynamic network of biological, chemical and physical interactions between themselves and with the non-living components.
  8. Common Property Resources (CPR) include all such resources which are meant for common use of the villagers but not for individual possession. These resources are an indispensable aspect of the social and institutional arrangements made to meet the everyday requirements of village communities. They are particularly important to the landless, the agricultural labours and rural artisans.

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## 1.5 SUMMARY

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- Environment is the life support system on which the existence and perpetuation of all living organisms depend. The present day environment can be considered to have physical, chemical, biological, scientific and technological components in which the organisms remain embedded.
- Environment has been derived from the French word 'Environ' which implies 'to encircle or surround.' All living and non-living things surrounding us comprise the environment. According to the Environment (Protection) Act 1986, 'environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.
- The concept of determinism is a complex phenomenon. It states that whatever things are found in nature depends on their present status or conditions and the facts how things are affected by the natural laws.
- The different types of determinism are causal determinism, historical determinism, nomological determinism, Necessitarianism, Predeterminism, Fatalism, theological determinism, etc.

- Some of the factors affecting determinism are:
  - o Interrelationship among individuals
  - o Grouping
  - o Continuous existence
  - o Likings or disliking
  - o Infirmity and mortality
  - o Coping Strategies
- Possibilism is a theory of geographical culture that explains that environment has certain limitations. Its culture is defined by the actions of human beings.
- Possibilism explains the relationship between the human and physical environment. Humans have a specific ability to adjust with the environment by modifying their responses. They react to the changes in environment according to the stimulus they receive from it. It is directly matched with the concept of environmental determinism which is in favour of the fact that the environment is responsible for shaping, limiting and controlling the development of culture.
- Taylor, in 1920s put forward the concept of neo-determinism. He believed that agricultural production mostly depended on the physical environment. As agriculture is affected by physical nature of environment the economy of the country is also affected. The producers of agricultural products are the main agents who play an important role in the economic progress of the country.
- A wide range and variety of organisms are present on earth from the single-celled amoeba to huge sharks, from microscopic blue-green algae to massive banyan trees. It includes all plants and animals which can be clubbed in various ways under different categories.
- Any assemblage of populations living in a prescribed area or physical habitat that has characteristics in addition to its individual and population components can be called a community.
- The sum total of all the ecosystems on planet Earth is called the biosphere, which includes all living organisms on earth, interacting with the physical environment as a whole, to maintain a steady-state ecosystem.
- The term ecosystem is made up of two words: eco and system. Eco means ecological sphere or a region of space where living things can exist, while system mean interacting organisms living in a particular habitat (living space).
- An ecosystem has both structure and function. The structure tells about the diversity of species, as function involves the flow of energy and cycling of materials through the structural components.
- For many years, Indian villagers have been dependent on forests for fuel wood to cook food. Deforestation was not immense when the population was less. However, with growing needs of the ever-increasing population, the situation has changed over the last few decades

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- Ecologically sustainable development is about keeping ecosystems healthy. It is about interacting with ecosystems in ways that allow them to maintain sufficient functional integrity to continue providing humans and all other creatures in the ecosystem the food, water, shelter and other resources that they need.
- Understanding the relationship between air pollution and ecosystem services is vital for achieving sustainable development of the communities. Air is a precious resource that supplies us with oxygen, which is essential for us. Air quality primarily influences the atmosphere in which people live and breathe.
- The current energy use of the poor is neither sufficient to attain the sustainable development nor is it sustainable in terms of maintaining important ecosystem services that can facilitate a transition out of poverty.
- Another important ecosystem resource which is important to discuss in the present scenario is biodiversity. Biodiversity provides both tangible and intangible benefits like food, fodder, fibre, fuel, climate regulation, flood and drought control, nutrient recycling, cultural and recreational benefits.
- The ecosystem resources, both natural and artificial, play a very vital role in the discharge of ecosystem services of provisioning, regulating, supporting and recreating.
- Common Property Resources (CPR) include all such resources which are meant for common use of the villagers but not for individual possession. These resources are an indispensable aspect of the social and institutional arrangements made to meet the everyday requirements of village communities.
- The capability of an ecosystem to endure disturbances like storms, fire and pollution, without changing its form, is known as ecosystem resilience. If a resilient ecosystem is damaged, it has the ability to repair itself.
- Ecological balance or ecosystem stability implies a balance between the production and consumption of each component in the ecosystem.
- If there is diversity of food webs, it will lead to an increase in the number of links in the food web and if community succession operates in an ecosystem, the stability will increase.
- The equilibrium as well as non-equilibrium model can explain stability. Thus, if the ecosystem is disturbed by external factors, it may quickly return to its original state by some adjustments, restoring the stability.
- When an ecosystem is unable to adjust to the environmental changes, it is said to be unstable. The instability occurs due to a number of natural and anthropogenic activities such as destruction of natural vegetation and animal species, partly or completely or by replacing them by other vegetation and animals, introduction of toxic substances like insecticides and pesticides and toxic gases like SO<sub>2</sub> and NO<sub>2</sub>.



- During the past decades, due to rapid increase in technology and population, humans have far more influenced their own environment than any other ecosystem.
- Although, ecology is considered a branch of biology, it deals with many other branches of science, such as chemistry, physics, geology, geography, meteorology, pedology, etc.

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### 1.6 KEY TERMS

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- **Possibilism:** It is a theory of geographical culture that explains that environment has certain limitations. Its culture is defined by the actions of human beings.
- **Determinism:** It is the concept which explains that nature affects the physical, mental and moral mind sets and habits of mankind and determines the culture and behaviour of the individuals and the society.
- **Amoeba:** It is a type of cell or unicellular organism which has the ability to alter its shape, primarily by extending and retracting pseudopods.
- **Desertification:** This is a type of land degradation in which a relatively dry area of land becomes a desert, typically losing its bodies of water as well as vegetation and wildlife.

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### 1.7 SELF-ASSESSMENT QUESTIONS AND EXERCISES

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#### Short-Answer Questions

1. Write short notes on (a) Possibilism (b) Neo-determinism.
2. Mention the factors that influence determinism.
3. What is a community?
4. What do you mean by ecosystem?
5. What are the various resources in the ecosystems that sustain development?
6. Write a short note on common property resources management.
7. Briefly state the significance of the study of ecology as a field of knowledge.

#### Long-Answer Questions

1. Explain the concept of determinism.
2. Describe the different types of determinism.
3. Discuss the various components which form the part of ecology and ecosystem.
4. Analyse critically the concept of ecological balance and its relationship with ecosystem.

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## 1.8 FURTHER READING

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### NOTES

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# UNIT 2 GLOBAL EFFORTS TO PROTECT ENVIRONMENT

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### Structure

- 2.0 Introduction
- 2.1 Objectives
- 2.2 Background to International Efforts for Environmental Protection
  - 2.2.1 National Environmental Standards
  - 2.2.2 Product Standards
- 2.3 India's Efforts for Environmental Protection and Public Policy
  - 2.3.1 Land Laws
- 2.4 Acts, Regulations and Policies
- 2.5 Answers to 'Check Your Progress'
- 2.6 Summary
- 2.7 Key Terms
- 2.8 Self-Assessment Questions and Exercises
- 2.9 Further Reading

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## 2.0 INTRODUCTION

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International efforts have been aimed at taking a step towards averting the consequences of climate change. From the Stockholm Conference to the United Nations Conference on Environment and Sustainable Development, measures have been taken to promote sustainable development and create public awareness of global environmental issues. The government of India has also taken measures for the conservation and protection of natural resources by enacting various policies and regulations. This unit will discuss these measures in detail.

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## 2.1 OBJECTIVES

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After going through this unit, you will be able to:

- Discuss the measures taken for environmental protection at the international level
- Examine measures taken by the Indian government for the conservation and protection of natural resources

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## 2.2 BACKGROUND TO INTERNATIONAL EFFORTS FOR ENVIRONMENTAL PROTECTION

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In the early 1970s, scientists first raised the issue of global warming as an emerging global threat (SCEP, 1970). However, initially their voices of concern fell on deaf ears as growing economies continued to burn more fossil fuels in transportation

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and industries and clear more forests for agriculture thus producing more hydrocarbons. It took scientists, NGOs, international organizations and several governments 20 years to make the international community agree to a coordinated action against climate change.

In 1972, the Stockholm Conference took a step towards climate change, which is regarded as the beginning of global efforts in climate change. The first World Climate Conference held in Geneva in 1979 expressed concern about various atmospheric and other environmental issues. A series of similar conferences and workshops followed the Geneva Conference, which were attended scientists across the globe. However, such events received little attention from policymakers. One such event was held in Villach, Austria in the 1980s that considered the seriousness of the emission of gases such as CO<sub>2</sub>. At the 1985 Villach conference, an international group of scientists reached a consensus on the danger of significant global warming (WMO, 1986).

Afterwards, as a result of growing public pressure as well as the work of the Brundtland commission (WCED, 1987), the issue of climate change was taken up as a serious political concern by several governments across the world. The Toronto Conference held in 1988, came as a diplomatic breakthrough as a form of recommendation for the developing nations to cut down on their emission of carbon dioxide at least by 20 per cent by the year 2005. It was followed by the IPCC studies, especially the three extensive Assessment Reports in 1990, 1995 and 2001, which covered different facets of climate change.

### **Incorporating environment in economic analysis**

It is important to incorporate environment in economic analysis because it plays four important roles:

1. It is a provider of energy and raw materials inputs to producers and consumers.
2. It works as a receptacle for the waste products of producers and consumers.
3. It is a provider of amenities to consumers (e.g., recreation).
4. It is a provider of basic life-support functions for humans.

Traditional economic models have shown the tendency to ignore the role of the environment. However, the concern for the environment has increased in the past few decades. To ensure sustainable development, it is essential to keep in mind the interactions of the environmental and economic systems. Incorporating environment in economic analysis is very important as it:

- Estimates the value of reduced health risks and improved environment quality
- Presents the results of economic analysis, including non-monetary information
- Assesses and describes who pays the costs and receives the benefits of regulations

- Discounts and compares differences in the timing of benefits, costs and impacts
- Locates available data sources for conducting economic analyses

### **UN Conference on the Human Environment, 1972**

The UN conference on Human Environment was organized with the initiative of the Government of Sweden, which was held in Stockholm. The conference was attended by around 113 countries across the world. This episode was widely recognized as the beginning of modern political and public awareness of global environmental issues. Nonetheless, the conference discussed the problem of relationship between development and environmental degradation peripherally. A general framework was provided for conservation of human environment, by the Stockholm conference.

The Stockholm conference adopted the following three non-binding instruments:

1. A resolution on institutional and financial arrangement
2. A declaration containing 26 principles
3. An action plan containing 109 recommendations

These three non-binding instruments prepared the final stage negotiations on the environment. However, the most important contribution of the Stockholm conference was the development of a set of principles that formed the backdrop of all subsequent international negotiations on the environment. As per example, the principle 24 of its declaration calls for international cooperation to effectively control, prevent, cut down and eliminate adverse environmental impact in such a way, so that it does not compromise the sovereignty of an individual state. All states shall ensure that their activities pertaining to jurisdiction shall not cause any further damage to other states. Environmental protection to human rights as the norm is stated in Principle 1.

International negotiations on environmental protection were further motivated regarding environmental issues. The principles stated were refined in the next international conference on environment in Rio-de-Janeiro, Brazil in 1992.

The declaration of the Stockholm conference (1972) contained the following principles:

1. Human rights must be asserted, apartheid and colonialism must be condemned.
2. Natural resources must be safeguarded.
3. The earth's capacity to produce renewable resources must be maintained.
4. Wildlife must be safeguarded.
5. Non-renewable resources must be shared and not exhausted.
6. Pollution must not exceed the environment's capacity to clean itself.
7. Damaging oceanic pollution must be prevented.
8. Development is needed to improve the environment.

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

Some of the important recommendations made by the Stockholm conference are as follows:

1. Preparing short-term and long-term plans at regional, sub-regional and sectoral levels for the study and identification of the countries of the region concerned as well as the special problems of the least developed countries of the region and of countries with coastlines and inland lakes and rivers exposed to the risk of marine and other forms of pollution.
2. Evaluating the administrative, technical and legal solutions of various environmental problems in terms of both preventive and remedial measures, taking into account possible alternatives and or multi-disciplinary approaches to development.
3. Preparation, within the framework of international agreements, of legislative measures designed to protect marine and fresh water fisheries resources within the limits of the national jurisdiction.

### **World Commission on Environment and Development, 1983**

Before the Rio-de-Janeiro conference (1992), the World Commission on Environment and Development (WECD) was established by the UN General Assembly in 1983. Chaired by Norwegian Prime Minister Gro Harlem Brundtland,

the commission was outside the control of the governments and the UN system. The commission was asked to develop a 'Global agenda for change'. Brundtland, as part of the WECD mandate, wrote a report, 'Our common future', which is now famously known as the Brundtland report. In many ways, the Brundtland report to be a catalyst for changing the direction of international negotiations on environmental degradation and conservation. Most importantly, the report has popularized the concept of sustainable development that firmly relates environmental degradation with developmental activities.

Although the idea of sustainability has a long history, sustainability as a physical biological-social concept was first dealt with in the Brundtland report. In fact, it elevated the concept to the level of a global ethic. The most important contribution of the Brundtland report in international negotiations on the environment comprises two aspects. First, the Brundtland approach has placed human welfare and human beings above the concepts of environmental sustainability. Secondly, it has introduced the notion of social equity directly in environmental negotiations.

The United Nations Conference on Environment and Sustainable Development was prompted by the Brundtland report, which called for strategies to strengthen efforts to promote sustainable and environmentally sound development. The Brundtland report defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' It contains two key concepts:

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

### **International Environmental Law for Our Common Future**

Fitting with the title of the Brundtland report, 'Our common future', many international environmental laws, conventions and treaties have been formulated for the common future of mankind. These laws are collectively referred to as international environmental law. The overall examination of international environmental law reveals the eight principles, which are briefly described below.

- **Principle of State Responsibility:** State responsibility is a traditional principle of general international law which can be applied to environmental wrong doings. A state incurs state responsibility if it commits a breach of an international obligation that stems primarily from an international treaty, custom or judicial decision.

A state will be responsible if:

- o The wrongful act/omission has resulted in the breach of any international obligation.
- o The breach is committed by the agents of the state.
- o The wrong is done by a private individual and the state did not exercise due diligence to prevent the damage.

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- **Principle of Good-neighbourliness:** According to the most basic principle of international law, every state has an absolute authority to use and enjoy its own territory. However, according to the customary principle of good-neighbourliness, a state has to use its property in such a way that its action does not injure and harm the property or the legal interests of another state.
- Good-neighbourliness is a back door through which environmental law has entered the international field. For example, the trail smelter arbitration (1938 and 1941) dealt with the toxic fumes entering into the USA from the smelting operations carried out in the Canadian territory. As a result, the property of a US citizen was damaged. The arbitration held Canada responsible on the basis of violating the principle of good-neighbourliness.
- **Principle of Cooperation:** This is also a general principle of international law. It holds well in dealing with environmental problems. Global environmental problems cannot be managed without cooperation among states.
- **Principle of Sustainable Development:** Principle 3 of the Rio Declaration describes sustainable development as a tool that meets the needs of present generations without compromising the ability of future generations to meet their own. This principle is popularly known as the principle of integration between ecological and economic concerns. It is based on the understanding that the goals of environmental protection and economic development are complementary, and one cannot be achieved without the other.
- **Principle of Polluter Pays:** It means that the polluter has to pay for the consequences of pollution. That is, the polluter has the responsibility of bearing the costs of rectifying the environmental damage resulting from pollution. This principle has a special importance as far as the North-South relationship is concerned. The North has a major share in global pollution. So, the South demands that the North has to take greater responsibility and pay more for the costs for not adhering to pollution abatement measures.
- **Principle of Precaution:** We know that prevention is better than cure. There are some kinds of environmental damage of very serious and irreversible nature. In such cases, scientific uncertainties about the possible harm should not be used as a reason for postponing preventive actions.
- **Principle of Intergenerational Equity:** This is a principle of fairness. It requires us to remember that the earth is not the exclusive property of the present generation of human beings. It is a common endowment for the entire mankind. So, we should hold the planet earth in trust for future generations. We should use natural resources carefully and avoid causing unnecessary environmental damages which may cause suffering to future generations.

Here a Philippines court judgment of is worth mentioning. When the Philippines government gave permits for deforestation, 44 miners and an environmental organization challenged the government order. They contended that they were representing not only themselves but also future



generations. The court allowed them to represent the case of unborn future generations. This shows that intergenerational equity principle is gaining good acceptance.

- **Principle of Common but Differential Responsibility:** It is well recognized that the ill-effects of environmental degradation will eventually affect all countries. Therefore, all states have to assume the common responsibility for protecting the environment. But the share of the contribution cannot be equal. It has to be different because all countries do not have an equal capacity to maintain the environment. The states that pollute more and have higher capacity should share major responsibility in maintaining the environmental quality.

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### Agenda 21

In 1992, the United Nations Conference on Environment and Development (UNCED), held at Rio de Janeiro, adopted a declaration and a global agenda for management of the environment in the next century. The declaration is known as Agenda 21, which is a massive 800-page document. It contains the Action Programme for attaining sustainable development. It also classifies several important concepts of environmental management that have immediate relevance for the marine environment.

Agenda 21 lays down 115 specific programmes. It is a key document but not binding. Its recommendations are classified into different areas such as:

- socio-economic issues to protect and promote human health;
- conservation and management of resources such as combating deforestation, desertification and drought;
- promotion of sustainable agriculture and rural development;
- strengthening of networks consisting of women, NGOs, business, scientific and technological community, farmers through financial resources,
- transfer of environment-friendly technology,
- training,
- international legal instruments and mechanisms.

At present, there is no binding international charter which contains general principles of international environmental law. During the preparations for UNCED, attempts were made to draft an earth charter which would have served this purpose. However, no agreement could be reached on the desirability of such an approach. Nevertheless, now there is an abundance of environmental instruments related to environmental issues, and it is possible to identify a number of basic principles on which these instruments are invariably based. Some of these principles, which we have already described above, are:

- The polluter pays principle
- The principle of non-discrimination
- The precautionary principle

- The principle of common but differentiated responsibility
- The principle of intergenerational equity

Most of these principles are reflected in the Rio Declaration on environment and development. A brief account of these principles is given Table 2.1.

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*Table 2.1 Basic Principles underlying International Instruments*

Principle	Description
The polluter pays principle	The polluter should bear the expenses of carrying out anti-pollution measures decided by the public authorities. The costs of these measures should thus be reflected in the costs of goods and services which cause pollution.
Principle of non-discrimination	Polluters causing trans-boundary pollution should be treated no less severely than they would be if they caused similar pollution within their own country.
Precautionary principle	Lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.
Principle of common but differentiated responsibilities	States should divide the costs of measures to protect the environment on the basis of the fact that they have made different contributions to global environmental degradation.
Principle of intergenerational equity	States are obliged to take into account the long-term effects of their actions affecting the environment. This principle attempts to emphasize that attention should not only be paid to long-distance effects but also to the long-term effects of human activity.

### 2.2.1 National Environmental Standards

Environmental standards refer to restrictions on trade in commodities, which are not subjected to certain environmentally damaging limits in their production or exploitation. The environmental standards are stiffly opposed by the developing countries. These countries see the linking of environmental and trade issues as a threat to their sovereignty and their economies. Their objections to trade measures to achieve environmental objectives are based on the following considerations:

- The ban on certain environment-unfriendly activities, like ban on ivory trade or ban on hardwood trade, has always gone against the economic interests of the developing countries.
- Trade barriers for environmental protection cause adverse effects on developing countries' exports for the following reasons:
  - o One, trade policy measures, usually, are not the best instruments for achieving environmental objectives. Trade sanctions do not directly address the root cause of environmental problems.
  - o Two, unilateral import restrictions are imposed following costly environmental standards, and such protectionist measures reduce the income both at home and abroad, especially in natural resource-rich developing countries.

- o Three, the environment-linked trade restrictions will lead to escalation in trade disputes resulting in retaliatory and counter-retaliatory measures.
- Environmental uses of trade policy are seen as inherently discriminatory. For instance, industrial countries had lower environmental standards at the earlier stage of their development.
- The developing countries contribute disproportionately small amount per capita to global environmental problems. For instance, in the global emission of carbon dioxide, the United States' share is a huge one-fourth.
- Differences in standards are a legitimate source of comparative advantage insofar as they reflect differences in resource endowments, preferences and abilities of various countries.
- Environmental standards rise along with the rise in the per capita incomes, and there is no point insisting on higher standards at lower incomes.
- Non-trade measures like labelling (e.g. 'dolphin-friendly tuna') would be friendlier.
- Outside pressure on the developing countries to raise their environmental standards would be used by domestic protectionist groups to argue against their governments' export-oriented development strategy.
- There will be a threat to the WTO rule-based multilateral trading system.

In the context of efforts to liberalize trade and investment flows, any attempt to link the environment with trade is likely to be counter-productive. There are strong objections to trade liberalization on the ground that it would lead to environmental destruction and more trade would mean more output and more income. And, this would lead to resource depletion and encourage location of environmentally degrading industries to countries with lower environmental standards and fragile natural environments. These developments are feared to contribute to further environmental damage. Many developing countries see environmental standards as backdoor measures of protection sought to be imposed by the developed countries.

A large number of international environmental issues are emerging and there is a growing pressure from different groups to have global multilateral environmental agreements on these issues. It is recognized that at least three broad classes of environmental issues require international solutions, which are as follows:

- First, regional problems arise when neighbouring countries share a common resource and, therefore, one country's actions affect others. In this category, we deal with most problems of trans-boundary pollution, including smog due to forest fires, acid rain and management of international rivers or regional seas.
- Second, the world shares certain global environmental resources such as the atmosphere and the deep oceans. Any action by one country that affects such "global commons" has an effect on all other countries. In this category, we include the build-up of greenhouse gases and the thinning of the ozone layer by the emission of CFCs.

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- Third, there are resources that clearly belong to one country but have value for the international community not reflected in the market. They include tropical rainforests, other special ecological habitats and individual species.

Different national environmental standards will be explained in the following sections.

### **Environmental Quality Standards**

Lack of universal environmental standards is considered a major cause of mass production technologies leading to rapid environmental degradation. In the backdrop of failing markets, the function of protecting the quality of the environment fell on the state. Since it has become evident that modernization resulted in several abnormalities like global warming, greenhouse effect and ozone depletion, it is proposed that governments impose a certain cess on resources/polluters leading to reduction of pollution levels.

The environmental standards may, quite legitimately, differ from one country to another. As pointed out by the Rio declaration, standards applied by some countries may be inappropriate in terms of economic and social costs to other countries, particularly the developing countries. As a result, the administrations in the Third World countries have been soft on polluting industries, fearing that strict regulation might impede the growth of industrialization. Varying environmental standards are the result of varying reasons such as local legislation, socio-economic priorities, cultural differences, carrying capacity of the environment, availability of new technologies and the size and complexity of industrial facilities.

Transnational corporations (TNCs) are the most important players involved in environment-damaging activities. Here are some examples of these activities:

- TNCs generate more than half of the greenhouse gases emitted by industrial sectors with the greatest impact on global warming.
- They have virtually exclusive control of the production and use of ozone-destroying CFCs and related compounds.
- In mining, they still dominate key industries and are intensifying their activities. In aluminium, for example, six companies control 63% of the mining capacity.
- In agriculture, they control 80% of the land cultivated worldwide for export crops, and 20 TNCs account for 90% of pesticide sales.
- They manufacture most of the world's chlorine, the basis for some of the most toxic chemicals including PCBs, DDT and dioxins.
- TNCs are the main transmitters of environmentally unsound production systems, hazardous materials and products to the Third World. For example, 25% of pesticide exports from the US in the late 1980s were chemicals banned or withdrawn in the US itself.
- They dominate the trade in, or the extraction or exploitation of, natural resources and commodities which contribute to depletion or degradation of forests, water and marine resources, and releasing of toxic wastes and unsafe products.

- Through advertising and product promotion, TNCS also promote a culture of unsustainable consumption

Along with the problems posed by TNCs, environmental resources in the developing countries also cause social conflicts in view of grave social inequalities. The deprived sections living around these resources stake their claims on them. Therefore setting environmental standards through legislation help vulnerable sections of society get their legitimate share in these resources and protect their rights. It would not be an exaggeration to state that the vulnerable, sections, more often than not, happen to be those that inflict less injury to the environment.

The following sections describe some environmental quality standards:

**Prohibition on the Use of Benzidine-based Dyes and its Salts:** The Government of India has notified the prohibition and restriction on the use of benzidine-based dyestuffs in the dyeing and colour processing industries.

The following chemical substances shall be classified as prohibited substances except when these substances are present or formed as byproducts of a chemical reaction in a total concentration not exceeding 1 per cent:

- Benzidine and its salts, and
- Any substance containing any of these compounds

All dyes and dye-intermediates containing benzidine and its derivatives shall be prohibited for handling. The prohibition on the handling of benzidine-based dyes is applicable to whole of India. Table 2.2 contains permissible levels of certain chemical substances in work environment.

**Standards for Emission of Smoke, Vapour, etc. from Motor Vehicles:**

As per Rule 3 and Schedule IV of Environment ( Protection) Rules 1986, the following observations are to be made with respect to emission of smoke, vapour etc. from motor vehicles:

1. Every motor vehicle is to be manufactured and maintained in such condition that smoke, visible vapour, grit, sparks, ashes, cinders or oily substances do not emit from them.
2. On and from the 1st day of March 1990, every motor vehicle in use shall comply with the following standards:
  - (a) Idling Co (carbon monoxide) emission limit for all four-wheeled petrol-driven vehicles shall not exceed 3 per cent by volume;
  - (b) smoke density for all diesel driven vehicles shall be as follows:

Method of Test		Maximum Smoke Density		
		Light Absorption Co-efficient m-1	Bosch Unit	Harridge Units
(a)	Full load at speed if 60% to 70% of maximum engine rated speed declared	3.1	5.2	75
(b)	Free acceleration	2.3	-	75

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3. On and from 1st day of April 1991, all petrol-driven vehicles shall be so manufactured that they comply with the mass emission standards as prescribed. The breakdown of the operating cycle used for the test shall be specified. The reference fuel for all such tests shall be as specified.

4. On and from 1st day of April 1991, all diesel-driven vehicles shall be so manufactured that they comply with the mass emission standards based on exhaust gas capacity as specified.

5. On and from 1st day of April 1992, all-diesel driven vehicles shall be so manufactured that they comply with the following levels of emissions under the Indian driving cycle:

Mass of carbon monoxide (Co) = 14  
(max. grams per KWH)

Mass of Hydrocarbons (HC) = 3.5  
(max. grams per KWH)

Mass of nitrogen oxides (No) = 18  
(max. grams per KWH)

**Standards for Domestic Water:** Water being an essential requirement of humans needs to be subjected to strict quality control.

### 2.2.2 Product Standards

Addition of environmental aspects and parameters in a data sheet, for example in case of electronic products, enables the customer and the recycler understand the life cycle aspects and impacts of the product. The data set frames, to be developed, will ask for answers to fundamental environmental issues and will address, in different stages, the changeable needs of customers. The benefit for a customer will be knowledge about the environmental characteristics of purchased products. It will be not easy for him to get this information from the suppliers of many modules of the product from all over the world.

In India, the state undertakings and large corporate are taking initiative to produce sustainable products. In Pondicherry, Suzlon Energy has built an entire office that runs on wind energy. ITC has brought out business papers that are made from recycled papers. Adjudged the best performer in the 2009-2010 Green Business Survey, Tamil Nadu Paper Limited was awarded the Green Business Leadership Award in the Pulp and Paper Sector. The initiatives undertaken by this top green firm in India includes two Clean Development Mechanism projects and a wind farm project that helped generate 2,30,323 Carbon Emission Reductions earning Rs. 17.40 crore. Hindustan Computers Ltd. is committed to phasing out the hazardous vinyl plastic and Brominated Flame Retardants from its products and has called for a Restriction on Hazardous Substances (RoHS) legislation in India. The IndusInd bank has opened its first solar-powered ATM in India.

In the past, facility executives used to face lots of problems when the paints touted as green did not perform on many environmental aspects. Early versions of environmentally responsible paints didn't perform better than their conventional

counterparts. That's not normally the case anymore. Industry experts believe that many of today's paints and coatings have a much lower impact on the environment than their predecessors, but still cover properly, look better and hold up.

The performance of many of current water-based paints rivals that of solvent-based paints, yet they normally have less of an impact on the environment, says Cris Crissinger, associate with McMillan Smith & Partners Architects. Earlier versions of water-reducible (that is, cleanup requires only soap and water) paints often didn't adhere well and weakened when they came into contact with soap and water. However, recent versions of water-reducible paints are regularly made of acrylic, and most perform as well, if not better than, many solvent-based paints, according to Crissinger.

Such colours and paints should be used, which are environmental friendly preferably at an affordable price. Green paints, especially those that are disposable, are relatively low priced. In addition, organizations usually do not have to track them as hazardous materials.

In order to select, the best paint for the application that has a minimal effect on the environment. Facility executives should review the environmental standards published by several different groups. Doing so can help determine which standard best measures the performance and environmental attributes important to their application.

Several environmental labelling organizations have issued standards for paints and coatings. Some of these organizations have been described below:

**Green Seal:** An US-based eco-labelling organization, Green Seal ensures protecting the environment. Any product, bearing the Green Seal certification mark is supposed to have less impact on the environment and human health. Usually, top 15 to 20 per cent of products in a category can earn a Green Seal label, according to Mark Petruzzi, vice president of certification with Green Seal. In analysing paints, Green Seal has many factors, Volatile Organic Compounds (VOC) being one of them. For getting earn Green Seal certification, non-flat interior paint must have fewer than 150 grams of VOCs per liter of product, minus water.

Additionally, Green Seal considers whether chemical compounds it considers hazardous were used in manufacturing paint. These comprise benzene, naphthalene and mercury, among others. For getting Green Seal certification, none can be present in paint. The casing of paints bearing the Green Seal certification identification should also include a statement that discourages consumers from pouring paints down a drain. Lastly, the paint cans should not have been manufactured with lead.

Green Seal's standards are made in a public forum. During the course of developing standards, members of the industry and the public are allowed to submit comments, which Green Seal employees consider. 'Everything is open and transparent,' says Petruzzi.

Previously, Green Seal's standards had come under some criticism by those who said the standards ignored the performance aspect. Clearly, if a product performs so weakly that users have to replace it or re-do their work, its

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environmental benefits will be decreased. Petruzzi points out that Green Seal does describe that a product performs its intended function. For instance, interior paints should meet standards for abrasion resistance, hiding power and stain deletion to get the Green Seal mark.

**Master Painters Institute:** Another standard-setting group is the Master Painters Institute (MPI), which was started in 1995. Initially, MPI was into formulating performance standards for paints, according its president Barry Law. After some years into work, the group started getting queries regarding VOCs in several paint categories. Then it started making green performance standards with respect to paint's environmental attributes as well as performance. In May 2005, MPI issued its Green Performance Standard. The standard provides a database of paint products that meet requirements for performance and durability, and also criteria for environmental impact. 'It takes a list of approximate 2,000 products and boils it down to 500 that meet the standard,' says Law.

Through MPI's standards one can easily find requirements for attributes such as scrubability and hiding power that paints should meet. These standards also list chemicals which are not allowed as ingredients in paints, and maximum levels of VOCs permitted. However, MPI's performance has come under criticism by some who tell that their standard-setting procedure is not as open as it must be.

**Green Guard:** Greenguard Environmental Institute looks after indoor air quality, according to Henning Bloech, director of communications, Greenguard. 'We look at the chemicals that, when you paint, may off-gas and have an impact on indoor air and the building's occupants,' he says.

For example, formaldehyde, which is sometimes used as a preservative, can lead to nausea and eye irritation. Facility executives must check any paints for presence of chemicals which have been recognized as carcinogens or toxins. To find out the effect a certain type or brand of paint may have on indoor air quality, Greenguard paints an 8 inch-square piece of dry wall and then puts it in an environmental test chamber, where pure, treated air is blown over it. Testers then measure the presence of several chemicals in air as it leaves the chambers. This testing is essential, as even paints that can claim that they are 'no-VOC' or 'VOC-free' may release some VOCs during the course of drying. To get Greenguard certification, paints should meet the organization's limits for VOC emissions as described below:

*Zero VOC:* Any paint with VOCs in the range of 5 grams/litre or less can be called 'Zero VOC' according to the EPA Reference Test Method 24. Some manufacturers may claim 'Zero-VOCs', but these paints may still use colorants, biocides and fungicides with some VOCs. Adding a colour tint usually brings the VOC level up to 10 grams/litre, which is still quite low.

*Low VOC:* Low VOC paints, stains and varnishes use water as a carrier instead of petroleum-based solvents. As such, the levels of harmful emissions from them are lower than from solvent-borne surface coatings. These certified coatings also contain no, or very low levels, of heavy metals and formaldehyde. The amount of VOCs varies among different 'low-VOC' products, and is listed on the paint can or MSDS. Paints and stains, to meet EPA standards, must not contain VOCs



in excess of 200 grams per litre. Varnishes must not contain VOCs in excess of 300 grams per litre. As a general rule, low VOC paints, marketed by reputed paint manufacturers, usually meet the 50 g/L VOC threshold. Paints with the Green Seal Standard (GS-11) mark are certified lower than 50 g/L (for flat sheen) or 150 g/L (for non-flat sheen). Low VOC paints will still emit an odour until dry. If you are particularly sensitive, make sure the paint you buy contains fewer than 25 grams/litre of VOCs.

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### **Standards for Process and Production Methods**

Nothing is more important than protecting the precious environment that sustains our life. This important and politically sensitive issue has given birth to a broad range of technological developments for the abatement and disposal of air pollutants. Some chemicals even at very low concentration levels in the environment pose a threat to human health and vegetation. An acceptable emission level for hazardous chemicals has, therefore, to be first defined. This has already been done by India's Central Pollution Control Board for some chemicals. Such emission level should be established for all hazardous chemicals. The US Environmental Protection Agency has national air pollution standards for five toxic substances — asbestos, benzene, beryllium, mercury and vinyl chloride. The agency's standard of performance for new stationary sources specifies the maximum permissible emission levels of carbon monoxide, fluoride, nitrogen oxides, particulate and sulphur dioxide from the following sources — asphalt concrete plants, basic oxygen steel furnaces, coal preparation plants, diammonium phosphate plants, electric arc, steel furnaces, fluid cat-cracker, incinerators, nitric acid plants, petroleum storage tanks, portland cement plants, primary aluminium reduction plants, etc. The limit for general public has to be much lower, say, in the range of 1/10th to 1/100th of the TLVs.

After establishing the mission limit, emission sources have to be identified from the process. This needs a detailed study of the process. In a chemical plant, generally a well designed control system is attached to the vent of the process vessels. For the toxic and low-boiling inflammable chemicals, emissions from sources other than the main process vent, like storage tank vent, may sometimes become more important than even those from the process vent. When such chemicals are being handled, the entire process should be studied and all emission points identified.

As prescribed in Factory Rules, there are many manufacturing operations which are standardized with respect to the environment, health and safety aspects. These operations are:

1. Manufacturing of aerated water and processes
2. Electrolytic plating and oxidation of metals
3. Manufacture and repair of accumulators
4. Glass manufacturers
5. Grinding of glazing of metal processes
6. Manufacture of lead and treatment of lead and certain compounds
7. Generation of gas from dangerous petroleum

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8. Cleaning, smoothing of any part or surface of articles
9. Liming and tanning of raw hides and skins and process incidental
10. Manufacture of chromic acid or manufacture or recovery of the bichromate of sodium, potassium or ammonium
11. Manufacture or manipulation of carcinogenic dye intermediates
12. Manipulation of acids or alkalis
13. Manufacture of bangles and other articles from cinematograph film and toxic and inflammable solvents
14. Process involving manufacture, use or evolution of carbon disulphide and hydrogen sulphide
15. Manufacture and manipulation of dangerous pesticides
16. Compression of oxygen and hydrogen produced by the electrolysis of water
17. Handling and processing of asbestos, manufacture of any article of asbestos and any other process in which it is used
18. Manufacture of articles from refractory materials including manufacture of refractory bricks
19. Process of extracting oils and fats from vegetables and animal sources in solvent extraction plants
20. Manufacture and use of benzene or its allied products
21. Manufacturing process or operations in carbon disulphide plants
22. Operations involving high noise levels
23. Welding/cutting operation with the use of LPG/Acetylene/Argon
24. Manufacture of pottery
25. Operations in Foundries

The effective methods to control air pollution are:

- (i) Change in raw material
- (ii) Installation of air pollution equipment
- (iii) Providing higher stocks to discharge pollutants at higher altitudes of the atmosphere.

**Change in Raw Material:** The emission of pollutants can be reduced by the substitute of raw material or its structure. A raw material can be substituted by another material to reduce pollution.

Following are examples where substitution of a raw material by another material lessens air pollution:

- Using cold setting synthetic resin for rubber in the manufacture of brushes as substitute to vulcanization.
- Adopting unleaded petrol to reduce lead concentrations in ambient air released by vehicles.

- Preferring low-sulphur fuels in place of high-sulphur fuels for reducing the emission of SO<sub>2</sub>.

**Change in Process:** Air pollution can be reduced by changing or modifying the processes in the industries. Some examples of are process modification are:

- Adoption of two-stage combustion for reducing the emission of NO<sub>2</sub>.
- By reduction of air, when burning fossil fuels, oxidation of SO<sub>2</sub> to SO<sub>3</sub> is reduced thus checking the formation of H<sub>2</sub>SO<sub>4</sub>. But this process may lead to soot formation.
- Use of electrical furnace in place of open-heart furnace in the steel and other industries.

### Performance Standards

Following are the performance standards enunciated by the International Finance Corporation:

- *Performance Standard 1: Social and Environmental Assessment and Management System*
- *Performance Standard 2: Labour and Working Conditions*
- *Performance Standard 3: Pollution Prevention and Abatement*
- *Performance Standard 4: Community Health, Safety and Security*
- *Performance Standard 5: Land Acquisition and Involuntary Resettlement*
- *Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management*
- *Performance Standard 7: Indigenous Peoples*
- *Performance Standard 8: Cultural Heritage*

Performance Standard 1 establishes the importance of: (i) integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of social and environmental performance throughout the life of a project. Performance Standards 2 through 8 other performance standards establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describe potential social and environmental impacts that require particular attention in emerging markets. Where social or environmental impacts are anticipated, the client is required to manage them through its social and environmental management system consistent with Performance Standard 1. In addition to meeting the requirements under performance standards, clients must comply with applicable national laws, including those laws that implement host country obligations under international law.

A set of Guidance Notes, corresponding to the Performance Standards, offers helpful guidance on the requirements contained in the Performance Standards,

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including reference materials, and on good sustainability practices to help clients improve project performance.

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### Check Your Progress

1. In which year was the first World Climate Conference held?
2. Who established the World Commission on Environment and Development (WECD)?
3. State any two environment-damaging activity of TNCs.

## 2.3 INDIA'S EFFORTS FOR ENVIRONMENTAL PROTECTION AND PUBLIC POLICY

Environmental laws are the laws for protecting soil, air, water, the oceans and biodiversity, as well as laws which protect the environment as a whole. They can protect areas of land or ocean and individual species. They necessitate the conducting of environmental impact assessment (EIA) before an activity gets the approval of the enforcing agencies. They may also require people to remediate any environmental damage they cause. Environmental laws come under both common laws and criminal laws.

Common laws are the laws developed by the courts over many years. There are a number of common law principles which are relevant to protecting the environment, especially in the issues involving a dispute between neighbours. A criminal law states that to do something is an 'offence' and imposes a fine or custodial sentence on an offender. An example of a criminal environmental law is that it is an offence for any person to cause pollution or allow it to be caused. Criminal laws can be enforced by prosecution, which means the person who is alleged to have committed the offence is formally charged and required to attend court.

Laws such as the Environmental Protection Act, 1986, the Air (Prevention and Control of Pollution) Act, 1981, and the Water (Prevention and Control of Pollution) Act, 1974, are discussed in this section. Let us discuss it in detail.

### 1. The Environmental (Protection) Act 1986

The objectives of this act are to provide for the protection and improvement of environment and for matters connected there with. This protection and improvement of environment in turn protects human beings, other living creatures, plants and property from hazards.

As per this Act, the central government is empowered to take all such measures as it deems necessary for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution.

## **Main provisions**

1. No person carrying on any industry, operation or process shall discharge or emit or permit to be discharged or emitted any environmental pollutants in excess of such standards as may be prescribed.
2. No person shall handle or cause to be handled any hazardous substance except in accordance with such procedure and after complying with such safeguards as may be prescribed.
3. The person responsible for discharge of any environmental pollutant in excess of the prescribed standards is bound to prevent or mitigate the environmental pollution caused and shall also forthwith intimate the fact of such occurrence or apprehension of such occurrence to the authorities concerned. The person is also bound to assist the authorities in attending to the work if he is required to do so.

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### **Environmental laboratories**

As per Section 12 of the Act, the central government can establish one or more environmental laboratories or recognize one or more laboratories or institutes as environmental laboratories to carry out the functions entrusted. The central government may also make rules for the functions and procedures to be followed by such laboratories. Taking samples of air, water, soil or other substances for analysis and the form of the laboratories reports and the fees payable for such report, etc., will be chalked out by the central government.

### **Penalty for contravention of the provisions**

Whoever fails to comply with or contravenes any of the provisions of this Act or rules shall in respect of each failure or contravention, be imprisonment for a term which may extend to five years or with fine which may extend to one lakh rupees or with both. In case the failure or contravention continues, an additional fine of five thousand rupees per day is liable.

### **Offences by companies**

Where any offence under this Act has been committed by a company, every person who, at the time of the offence was committed was directly in charge of, and was responsible to the company for the conduct of the business of the company shall be deemed to be guilty of the offence and shall be liable to be proceeded against and punished.

### **Protection of action taken in good faith**

Section 18 of this Act states that no suit, prosecution or other legal proceeding shall lie against the government or any officer or other employee of the government in respect of anything which is done or intended to be done in good faith in pursuance of this Act or the rules.

### **Cognizance of offences**

No court shall take cognizance of any offence under this Act except on a complaint made by

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- (a) The central government or any authority or officer authorized on its behalf by the government or
- (b) Any person who has given notice of not less than sixty days, in the manner prescribed, of the alleged offence and of his intention to make a complaint, to the central government or the authority or officer authorized as aforesaid.

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

Following are the aims of the Air (Prevention and Control of Pollution) Act 1981:

1. To provide for the prevention and control of air pollution.
2. To establish air pollution control boards for carrying out prevention and control of air pollution.
3. To assign functions and confer powers on the boards after establishment.

#### **Central and state boards**

Central Pollution Control Board constituted under Section 3 of Water (Prevention and Control of Pollution) Act 1974 shall have the powers and perform the functions of the Central Pollution Control Board for the prevention and control of air pollution under this Act. State Pollution Control Boards constituted under Section 4 of Water (Pollution and Control of Pollution) Act 1974 will also be functioning as state boards under this Act.

The members of Central and State Boards for the Water (Prevention and Control of Pollution) Act will be the same for the Air (Pollution and Control Pollution) Act. The frequency of board meetings will also be the same (once in 3 months or earlier).

#### **Restrictions regarding certain industrial plants**

The state government, after consulting the State Board can prohibit the following aspects in the specified pollution control areas:

1. The use of any fuel (other than approved fuel) which is likely to cause air pollution.
2. No appliance other than an approved appliance can be used in the premises situated in an air pollution control area.
3. Burning of any material (not being fuel) in any air pollution control area is prohibited since the same may cause air pollution.

#### **Power of entry and inspection**

Any person empowered by a State Board shall have a right to enter at all reasonable times with required assistance as he considers necessary.

#### **Power to obtain information**

For the purpose of carrying out the functions entrusted to it, the State Board or any office empowered by it can call for any information (pertaining to the types of air pollutants) from the occupier of any industry or industrial plant/control equipment for the purpose of verifying the correctness of such information. The officer of State Board can inspect the premises where he finds it necessary.

### **Power to take samples of air or emission**

Any State Board or any officer empowered by it will have the power to take samples of air or emission from any chimney, flue or duct or any other outlet for the purpose of analysis.

The person taking the samples will issue notice to the occupier (of the place/plant) stating his intention of carrying out analysis of air. The sample of air will be collected in the presence of the occupier or his representative. The collected air sample will be placed in a container (or containers) which then will be marked and sealed. Signatures of both the person taking the sample and the occupier or his agent will be affixed on the samples collected. The containers with the collected samples of air will then be sent to the laboratory established or recognized by the State Board.

### **Penalties and procedure**

Failure to carry out the directions of State Board will bring about the following penalties on the occupier or the person concerned.

In respect of each failure (for example, establishing a plant in the pollution control area) the occupier is punishable with imprisonment for a term which shall not be less than one year and six months, which may extend to six years and with fine and in case failure continues, with an additional fine which may extend to five thousand rupees for every day during which such failure continues after the conviction for the first such failure.

If the failure referred above continues beyond a period of one year after the date of conviction, the offender shall be punishable with imprisonment for a term which shall not be less than two years but which may extend to seven years and with fine.

### **Penalties for certain acts**

The following acts are punishable:

1. Destroying, pulling down, removing, injuring or defacing any pillar, post or stake fixed in the ground or any notice or other matter put up, inscribed or placed, by the State Board.
2. Obstructing any person acting under the orders or directions of the Board from exercising his powers and performing his functions under this Act.
3. Damaging any works or property belonging to the board.
4. Failing to furnish to the Board or any officer or other employee of the board any information required by the Board or such officer or other employee for the purpose of this Act.
5. Failing to intimate the occurrence of the emission of air pollutants into the atmosphere in excess of the standards laid down by the State Board.
6. Furnishing false statement for getting consent for the establishment of his need.

All the above acts are punishable with imprisonment for a term which extends to three months or with fine which may extend to ten thousand rupees or with both.

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### 3. The Water (Prevention and Control of Pollution) Act 1974

Following are the aims of Water (Prevention and Control of Pollution) Act 1974:

- (i) To provide for the prevention and control of water pollution.
- (ii) To maintain or restore the wholesomeness of water.
- (iii) To establish water pollution control boards for the prevention and control of water pollution.
- (iv) To assign suitable powers and functions for the water pollution control boards.

#### Central and state boards

This Act empowers the constitution of Central and State boards to exercise the powers conferred and perform the functions assigned to the respective boards under this Act.

#### Powers and functions of boards

The main function of the Central Board is to promote cleanliness of streams and wells in different areas of states. The other miscellaneous functions are as follows:

1. To advise the central government on any matter concerning the prevention and control of water pollution.
2. To coordinate the activities of the state boards and resolve disputes among them.
3. To provide technical assistance and guidance to the State Boards, carryout and sponsor investigations and research relating to problems of water pollution.
4. To plan and organize the training of persons engaged or to be engaged in programmes for the prevention, control or statement or water pollution on such terms and conditions as the central Board may specify.
5. To organize through mass media a comprehensive programme regarding the preventions and control of water pollution.
6. To collect, compile and publish technical and statistical data relating to water pollution and the measures devised for its effective prevention and control and prepare manuals, codes or guides relating to treatment and disposal of sewage and trade effluents and disseminate information connected there with.
7. To lay down, modify or annul in consultation with the state government concerned, the standards for a stream or well.
8. To plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water pollution.
9. To perform such other functions as may be prescribed.

#### Important provisions of the act

**Section 21:** This section empowers the nominated officials of State Board to take samples of water from any stream or well or samples of any sewage or trade effluent which is passing from any plant or vessel (for the purpose of analysis) such



samples will be collected after due notice is given to the occupier of the area in question.

**Section 22:** The samples collected as referred above will be analysed by the nominated official of recognized laboratory and he will submit a report of the results of such analysis. One copy of the report will be sent to the occupier and another copy will be preserved for production before the court in case any legal proceedings are taken against the occupier.

**Section 23:** This section empowers the nominated person of the Board to enter any place for the purpose of performing any of the functions of the Board entrusted to him. He is also empowered to examine any plant, record, register, document or any other material object or for conducting a search of any place in which he has reason to believe that an offence under this Act or the rules is suspected.

**Section 24:** This section deals with the prohibition on the use of stream or well for disposal of polluting matter, etc. It lays down that: 'No poisonous, noxious or polluting matter determined (as per the standards laid down by state Board) should be permitted to enter any stream or well or sewer or on land.'

**Section 25:** As per this section, 'No person shall without the previous consent of the State Board

- (a) Can establish or take any steps to establish any industry, operation or process or any treatment and disposal systems or any extension or addition there to which is likely to discharge sewage or trade effluent into a stream or well or sewer or on land.
- (b) Bring into use any new or altered outlet for the discharge of sewages or
- (c) Begin to make any new discharge of sewage.'

**Section 26:** According to this section, before the commencement of this Act, the person who was discharging any sewage or trade effluent into a stream or well or sewer or on land has to follow the rules of Section 25 mentioned above from a specific date as proposed by the state government.

**Sections 32 and 33:** In these sections, the provision relating to accidental or unforeseen discharge of polluted, poisonous or noxious matter into the stream or well is dealt with. If such accident or event takes place due to industrial operation or system, then the person incharge of such place has to inform the State Board about the occurrence of such accident or event. The State Board after assessing the extent of such polluted discharge into the stream or well can instruct the person to stop discharging the polluted matter. If necessary the Board can approach the local court in the matter for getting a judgement.

### Penalties and procedure

Failure to comply with the directions referred in the above sections (32 and 33) can result in the person's conviction and resultant punishment with imprisonment for a term of three months with or without fine to the extent of ten thousand rupees. If the failure continues, a fine of rupees five thousand for every day can also be levied. If the failure continues beyond one year period, then the person is liable for imprisonment of 2 years to 7 years period with fine.

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### 2.3.1 Land Laws

Various acts and legislations, such as the Forest Protection Act, the Wildlife Protection Act, the Biodiversity Act and the SEZ Act, are intended to protect the land and minority communities.

#### 1. Forest Protection Act 1927

The first Forest Act was enacted in 1927 and this is one of the many surviving colonial legislations. It was enacted to strengthen the law related to forests, the transit of forest produce and the duty liable on timber and other forest produce.

Subsequently, the Forest (Conservation) Act was promulgated in 1980 to make certain reforms over the proceeding Act of 1927. This act deals with the four categories of forests, namely reserve forests, village forests, protected forests and private forests. A state may declare forest lands or wastelands as reserved forest and may sell the produce from these forests. Any unauthorized felling of trees, quarrying, grazing and hunting in reserved forests is punishable with a fine or imprisonment or both. The reserved forest assigned to a village community is called village forest. The state governments are empowered to designate protected forest and may prohibit the felling of trees, quarrying and the removal of forest produce from such a forest. The preservation of protected forests is enforced through rules, licenses and criminal prosecutions. Forest officers and their staff administer the Forest Act.

#### 2. Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006

This Act is an outcome of the struggle by the marginal and tribal communities of our nation to assert their rights over forestland over whom they were conventionally dependent. This Act is essential to the rights of millions of tribal and other forest dwellers in different parts of our country as it provides for the compensation of underprivileged forest rights across India, as well as both individual rights to cultivated land in forestland and community rights over common property resources. The January 2008 notification of the rules for the execution of Forest Rights Act, 2006 has lastly paved the way to undo the 'historic injustice' done to the tribals and other forest dwellers. With the help of this Act, the life of around 100 million poorest of the poor tribals stands to improve if its implementation is taken seriously. The Act is important because it provides scope and historic opportunity of protecting the basic rights of these poor people.

#### This Act is a potential tool

- to make powerful as well as strengthen the local self governance;
- to deal with the living security of people, leading to poverty mitigation and pro-poor development; and
- to deal with the problems of conservation and management of the natural resources.

Certain rights are given in Section 3(1) of the Act. These may be summarized as:

- Title rights related to the ownership of land which is being under farming by tribals or forest dwellers as on 13 December 2005, subject to a maximum of 4 hectares; this ownership is only for land which is really being cultivated by the concerned family as on that date, and that no fresh lands are approved.
- The rights to use minor forest produce (including ownership also), grazing areas, pastoralist routes, etc.
- Relief and development rights such as rehabilitation when illegal eviction or forced displacement has happened and of necessary facilities, subject to limitations for forest protection.
- Forest management rights to preserve forests and wildlife.

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### 3. Wildlife Protection Act 1972

According to the Wildlife Protection Act 1972, the expression 'wildlife' includes any animal, bees, butterflies, fish and moths, and aquatic or land vegetation which forms part of any habitat.

The Wildlife Protection Act was passed by the Indian Parliament in 1972 to protect India's wildlife. However, even during the period after the Act came into force, the number of wild animals is going down alarmingly despite of government efforts to protect them. With the increase in population, there is greater pressure on land. Forests are being destroyed as human habitation expands, thereby shrinking the wildlife habitats. There is also the clandestine international trade in wildlife and wildlife products which is a major cause for their wanton destruction. Meanwhile, the growing consumer society and the increasing emphasis on luxury and vanity items have also caused the exploitation of wildlife in the name of industrial progress.

### 4. Coastal Regulation Zone Notification 2011

The Ministry of Environment and Forests (MoEF), Government of India issued its Notification S.O. 19 (E) dated 6 January 2011 on Coastal Regulation Zone (CRZ) replacing the earlier CRZ notification S.O. 114(E), dated 19 February 1991. Highlights of the notification are given below.

#### Objectives

- Conserve and protect coastal stretches, its unique environment and its marine area
- Ensure livelihood security to fishermen/other communities living in the coastal areas
- Restrict the setting /storage/ disposal of hazardous substances in the CRZ areas

#### CRZ Areas

These include coastal stretches of the country and the water area upto its territorial water limits (12 Nautical Miles), except the islands of Andaman and Nicobar and Lakshadweep, which are covered under a separate notification.

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### Classification of the CRZ:

1. CRZ-I: (Ecologically sensitive areas)
2. CRZ-II: (Built-up-Areas)
3. CRZ-III: (Rural Areas)
4. CRZ-IV: (Water Areas):

### Regulation of permissible activities

- Clearance shall be given for any activity within the CRZ only if it requires waterfront and foreshore facilities for listed projects under this notification.
- Activities not listed in the EIA notification, 2006; construction activities relating to projects of Department of Atomic Energy or Defence requirements for which foreshore facilities are essential; construction, operation of lighthouses; laying of pipelines, conveying systems, transmission line.

Procedure for clearance of permissible activities:

Following procedure will be applicable to projects attracting this notification:

- (i) Project proponents to apply with the following documents seeking prior clearance to the concerned State or the union territory Coastal Zone Management Authority (CZMA).
- (ii) Concerned CZMA to examine the above documents and make recommendations within a period of sixty days from date of receipt of complete application.
- (iii) MoEF or State Environmental impact Assessment Authority (SEIAA) shall consider such projects for clearance based on the recommendations of the concerned CZMA within a period of sixty days.
- (iv) The clearance accorded to the projects under the CRZ notification shall be valid for the period of five years from the date of issue of the clearance for the commencement of construction and operation.
- (v) For post clearance monitoring—
  - (a) Project proponent to submit half-yearly compliance reports to the regulatory authority(s) concerned, on 1st June and 31st December of each calendar year. All such compliance reports by the project proponent to be published in public domain and its copies shall be given to any person on application to the concerned CZMA.
  - (b) The compliance report also to be displayed on the website of the concerned regulatory authority.
- (vi) To maintain transparency in the working of the CZMA, it shall be the responsibility of the CZMA to create a dedicated website and post the agenda, minutes, decisions taken, clearance letters, violations, action taken on the violations and court matters including the orders of the Hon'ble Court as also the approved CZMA of the respective State Government or Union territory.

### **Preparation of coastal zone management plans (CZMA)**

The CZMA may be prepared by the State Government or Union territory by engaging reputed and experienced scientific institution(s) or the agencies including the National Centre for Sustainable Coastal Management (NCSCM) of MoEF and in consultation with the concerned stakeholders.

The notification provides detailed procedure for the preparation of CZMA.

Enforcement of the Notification, 2011:

- (i) For the purpose of implementation and enforcement of the provisions this notification and compliance with conditions stipulated thereunder, the powers either original or delegated are available under Environment (Protection) Act, 1986 with the MoEF, State Government or the Union Territory Administration NCZMA and SCZMAs.
- (ii) The State Government or the Union Territory CZMAs shall primarily be responsible for enforcing and monitoring of this notification. To assist in this task, the State Government and the Union Territory shall constitute district-level Committees under the Chairmanship of the District Magistrate concerned containing atleast three representatives of local traditional coastal communities including the fisher-folks.

### **5. Biodiversity Act 2002**

The Biodiversity Act 2002 aims to provide for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources. The act provides for the constitution of a National Biodiversity Authority at the national level, State Biodiversity Boards at the state levels and Biodiversity Management Committees at the local levels to implement the provisions of this Act.

India's richness in biological resources and indigenous knowledge relating to them is well recognized. One of the major challenges is in adopting an instrument which helps realize the objectives of equitable benefit sharing enshrined in the convention. Towards this end, the legislation on biodiversity was developed following an extensive consultative process. The legislation aims at regulating access to biological resources so as to ensure equitable sharing of benefits arising from their use. The Biological Diversity Bill, which was introduced in the Parliament on 15 May 2000, was referred to the Parliamentary Standing Committee for Science, Technology, and Environment and Forests for examination and evaluation.

#### **Salient features of the biodiversity legislation**

The main intent of this legislation is to protect India's rich biodiversity and associated knowledge against their use by foreign individuals and organizations without sharing the benefits arising out of such use, and check biopiracy. The Act provides for setting up of a National Biodiversity Authority (NBA), State Biodiversity Board (SBB) and Biodiversity Management Committees (BMCs) in local bodies. The NBA and SBB are required to consult the BMCs in decisions relating to the use of biological resources/related knowledge within their jurisdiction and BMCs are to promote conservation, sustainable use and documentation of biodiversity.

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All foreign national organizations require prior approval of the NBA for obtaining biological resources and/or associated knowledge for any use. Indian individuals/entities require approval from the NBA for transferring results of research with respect to any biological resources to foreign nationals/organizations. Collaborative research projects and exchange of knowledge and resources under these projects are exempted provided they are drawn as per policy guidelines of the central Government and have its approval regarding the objectives of conservations, sustainable use and benefits sharing. However, Indian citizens/entities/ local people including vaidas and hakims have free access to use biological resources within the country for their own use, medicinal purposes and research purposes.

### 6. Seeds Bill Act 2004

The Seeds Bill was presented in the Rajya Sabha on 9 December 2004. It was then referred to the Standing Committee on Agriculture.

#### Highlights of the Seed Bill

- The Seeds Bill 2004 aims to regulate quality of seeds sold, and replaces the Seeds Act 1966.
- The Bill does not restrict the farmer's right to use or sell his farm seeds and planting material, provided he does not sell them under a brand name. All seeds and planting material sold by farmers will have to conform to minimum standards applicable to registered seeds.
- All varieties of seeds for sale have to be registered. The seeds are required to meet certain prescribed minimum standards.
- The Bill permits self-certification of seeds by accredited agencies and allows the central government to recognize certification by foreign seed certification agencies.
- If a registered variety of seed fails to perform to expected standards, the farmer can claim compensation from the producer or dealer under the Consumer Protection Act 1986.
- Every seed producer and dealer, and horticulture nursery has to be registered with the state government.

#### Key issues and analysis

- Although farmers are exempt from registering their seed varieties, the seeds have to conform to standards prescribed for commercial seeds. Farmers may find it difficult to adhere to the standards required of commercially sold seeds.
- Some provisions of the Seeds Bill 2004 contradict and overlap with the Protection of Plant Varieties and Farmers' Rights Act 2001 (PPVFR Act).
- Seed inspectors can take samples from anyone selling purchasing or transporting seed. They have the power of search and seizure without a warrant.

- Compensation for underperformance of seeds will be governed by consumer courts. This provision is unlike the PPVFR Act, which allows compensation to be decided by the authority established under that Act.
- It is not clear whether the Bill bans certain genetic engineering technologies such as ‘genetic use restriction technology’ and ‘terminator technology’. These technologies preserve intellectual property rights by either requiring specific additives, or by making the next generation seeds sterile.

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### Key features

The Bill aims to promote the production and supply of quality seeds. It will regulate the quality of seeds for sale, import and export. The proposed Act replaced the Seeds Act 1966.

- Registration and Certification
- Rights of farmers
- Regulatory structure
- The Central Government shall establish the Central Seed Committee (CSC), consisting of a Chairperson, seven ex-officio members and thirteen members nominated by the Central Government.
- State Seed Committees would advise the CSC and the State Government on issues related to the registration of local seeds, and of producers, dealers and nurseries.
- The Registration Sub-Committee would register the varieties of seeds after scrutinizing their claims in the prescribed manner.
- The Central Government shall constitute an appellate authority consisting of a single person or three persons.
- Central and State Seed Testing Laboratories would analyse all varieties of seed.
- State governments would appoint seed inspectors.
- Import and export: Import of seeds would be subject to the Plant Quarantine (Regulation of Import into India) Order 2003 or any corresponding order under the Destructive Insects and Pests Act 1914.
- Penalties: Any person who contravenes any provisions of the Act or imports, sells or stocks seeds deemed to be misbranded or not registered, can be punishable by a fine between Rs 5,000 and Rs 25,000.

### 7. National Environmental Tribunal and Green Benches

The laws and regulations play an important role in environmental management but require institutional mechanisms for their implementation and enforcement. As a citizen you can seek relief in the courts from unjust laws and actions in two ways:

1. By bringing a civil suit, asking for payment of damages that were caused by a private individual, corporation and governmental agency and that injured you or your property.

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2. Ask for a judgement by the court about the constitutionality of the laws passed by the government or the adequacy and legality of regulation established by an administrative agency. If the court finds a law or regulation to be improper, it can issue an injunction to stop the implementation or application of that law or regulation and may even direct what the new regulation should be.

In the 1960's and 70's, the judicial branch of our government was highly responsive to environmental and social concern especially in the first world countries. The environmental tribunals established by many countries have become an important part of legal framework for environmental management. However, there are several problems faced by the citizens who want to seek relief in these courts.

The National Environmental Tribunal Act has been enacted to provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance. The National Environment Tribunal was established for effective and expeditious disposal of cases arising from such accidents, with a view to giving relief and compensation for damages to persons, property and the environment and for matters connected herewith or incidental thereto.

### **Green benches in India**

Green benches are those constituted by the chief justice of the respective high courts either on their own or on directions from the chief justice of the supreme court to constitute exclusively a bench (quorum consisting of more than one judge) to deal with matters relating to environment and connected there with. The green bench in the respective high court deals with matters relating to environment either on a particular day of the week exclusively or when and where the situation demands immediate action. West Bengal and Tamil Nadu are the examples of some states which have constituted Green Benches.

### **8. The SEZ Act 2005**

In view of providing an international aggressive background for export, the Government of India declared the SEZ Scheme. The purpose of SEZ (special economic zone) is to help available goods and services free of tax and duties which are supported by integrated infrastructure for export manufacturing fast and prompt single window approval system and package of incentives to attract foreign and domestic investment for encouraging export-led development. For giving a long-term and proper policy framework with minimum regulatory regime, the central act has been found essential.

### **Objectives**

The Government of India declared an SEZ Scheme and presently there are 11 operation zones. Of these, 7 have been constructed by the Central Government and 4 by Private/Joint ownership. The SEZ policy is contained in foreign trade policy and several incentives and amenities offered are implemented through many Notifications and Circulars issued by the relevant Ministries/Departments.



## **Comments**

The SEZ is established for export purpose and it is dealt as if it is a foreign area within India. The units in the SEZ can trade in inputs and capital goods without paying of customs duty and purchase indigenous inputs and capital goods without paying of excise duty.

### **Guidelines for notifying SEZ (Section 5)**

The Central Government when notifying any area as SEZ or another area to be integrated in SEZ and discharging its functions under this Act will be guided by the following: (1) Creation of other economic activity; (2) Encouragement of exports of goods and services; (3) Encouragement of investment from domestic and foreign sources; (4) Generation of employment enhancements; (5) Improvement of infrastructure facilities; and (7) Maintaining sovereignty and integrity of India, the security of State and friendly associations with foreign state.

**Development Commissioner (Section 11/12):** The Central Government can employ any of its officers, who are not less than the rank of Deputy Secretary to Government of India, as the Development Commissioner of one or more SEZs. The Development Commissioner will supervise all steps in order to fulfill his functions under this Act and ensure the prompt progress of the SEZ.

**SEZ and Taxation—exception from tax, duties or cess (Section 7):** Any goods or services exported from or imported to India or produced from the Domestic Tariff Area (DTA) by Unit in SEZ or Developer, will subject to such terms and conditions and boundaries as recommended to be exempt from payment of tax, duties or cess under the notification given in the 1st Schedule.

## **9. The Energy Conservation Act 2001**

The strategy developed to make power available to all by 2012 includes the promotion of energy efficiency and its conservation in the country, which is found to be the least cost option to augment the gap between demand and supply. Nearly 25,000MW of capacity creation through energy efficiency in the electricity sector alone has been estimated in India. Energy conservation potential for the economy as a whole has been assessed as 23 per cent with maximum potential in industrial and agricultural sectors.

Considering the vast potential of energy savings and benefits of energy efficiency, the Government of India enacted the Energy Conservation Act 2001. The Act provides for the legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to embark upon energy efficiency drive in the country.

This Act has come into force with effect from 1 March 2002. Under Clause (d) of Section 15 of the said Act, the State Governments are required to designate an agency to coordinate, regulate and enforce provisions of the Act within the State.

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### Management of bureau

The authority of superintendence, direction and management of the affairs of the Bureau shall lie with the Governing Council which shall consist of not less than twenty members, but not exceeding twenty-six members appointed by the Central Government.

The Governing Council may exercise all powers and do all acts and things which may be exercised or done by the Bureau.

### Powers and Functions of the Bureau:

1. The Bureau shall effectively co-ordinate with designated consumers, designated agencies and other agencies; recognize and utilize the existing resources and infrastructure, in performing the functions assigned to it by or under this Act.
2. The Bureau may perform such functions and exercise such powers as may be assigned to it by or under this Act.

The Act empowers the Central Government to enforce efficient use of energy and its conservation and also empowers the State Governments to enforce certain provisions for the efficient use of energy and its conservation.

#### Check Your Progress

4. What is the Air (Prevention and Control of Pollution) Act 1981 aimed at?
5. Why was the Forest Protection Act 1927 enacted?
6. What is Biodiversity Act 2002 aimed at?
7. Name the states in India which has constituted Green Benches.

## 2.4 ACTS, REGULATIONS AND POLICIES

As discussed, the Environmental Protection Act, the Air (Prevention and Control of Pollution) Act and the Water (Prevention and Control of Pollution) Act have provided provisions in order to safeguard the environment. Let us have a look at these major acts related to the environment for e.g., air, water etc.

### Environmental Protection Act

The Act came into force on 19 November, 1986. The Act extends to the whole of India. Some terms related to environment have been described as follows in the Act:

1. Environment includes water, air and land and the interrelationship that exist among and between them and human beings, all other living organisms and property.
2. Environmental pollution means the presence of any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to the environment.

3. Hazardous substance means any substance or preparation which by its physico-chemical properties or handling is liable to cause harm to human beings, other living organisms, property or environment.

The Act has given powers to the central government to take measures to protect and improve the environment, while the state government coordinate the actions. The most important function of central government under this act includes:

Setting up of:

- (a) The standards of quality of air, water or soil for various areas and purposes.
- (b) The maximum permissible limits of concentration of various environmental pollutants for different areas.
- (c) The procedures and safeguards for the handling of hazardous substances.
- (d) The prohibition and restrictions on the handling of hazardous substances in different areas.
- (e) The prohibition and restriction on the location of the industries and to carry on processes and operations in different areas.
- (f) The procedures and safeguards for the prevention of accidents which may cause environmental pollution and providing for remedial measures for such accidents.

The power of entry and inspection, power to take samples, etc., under this Act, lies with the central government or any officer empowered by it.

For the purpose of protecting and improving the quality of the environment and preventing and abating pollution, standards have been specified under Schedule I-IV of Environment (Protection) Rules, 1986, for emission of gaseous pollutants and discharge of effluents/waste water from industries.

These standards vary from industry to industry and also vary with the medium into which the effluent is discharged or the area of emission.

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

The salient features of the act are as follows:

1. It provides for prevention, control and abatement of air pollution.
2. Air pollution has been defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be harmful to human beings or any other living creatures or plants or property or environment.
3. Noise pollution has been inserted as pollution in the Act in 1987.
4. Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to the Water (Prevention and control of pollution) Act, the boards perform similar functions related to the improvement of air quality.

The boards have to check whether or not the industry strictly follows the norms or standards laid down by the board under Section 17 regarding the

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discharge of emission of any air pollutant. Based upon analysis report, consent is granted or refused to the industry.

5. Just like the Water Act, the Air Act has provisions for defining the constitution, power and function of pollution control boards, funds, accounts, audit, penalties and procedures.
6. Section 20 of the Act has provision for insuring emission standards for automobiles. Based upon it, the state government is empowered to issue instructions to the authorities in charge of registration of motor vehicles (under Motor Vehicle Act, 1939) that is bound to comply with such instructions.
7. As per section 19, in consultation with the State Pollution Control Board, the state government may declare an area within the state as 'Air Pollution Control Area' and can prohibit the use of any fuel other than the approved fuel in the area causing air pollution. No person shall without prior consent of the State Board operate or establish any industrial unit in the 'Air Pollution Control Area'.

The Water and Air Acts have also made special provisions for appeals. Under Section 28 of the Water Act and Section 31 of the Air Act, a provision for appeals has been made. An appellate authority consisting of a single person or three persons appointed by the head of the state, the Governor is constituted to hear such appeals as filed by some aggrieved parties due to some order made by the state board within thirty days of passing the orders.

The appellate authority, after giving the appellant and the state board, an opportunity of being heard, disposes off the appeal as expeditiously as possible.

Penalties include a fine of up to Rs 5000 a day and/or imprisonment for up to one and a half to six years for first offence and fine of Rs 10000 a day and imprisonment of one and a half to six years.

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

It provides for maintaining and restoring the wholesomeness of water by preventing and controlling its pollution. Water pollution is defined as such contamination of water, or such alteration of the physical, chemical or biological properties of water or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful for any other use or to aquatic plants and other organisms or animal life.

The definition of water pollution has thus encompassed the entire probable agents in water that may cause any harm or have a potential to harm any kind of life in any way.

The salient features and provisions of the Act are summed up as follows:

1. It provides for maintenance and restoration of the quality of all types of surface and groundwater.
2. It provides for the establishment of Central and State Boards for pollution control.
3. It confers them with powers and functions to control pollution.

The Central and State Pollution Control Boards are widely represented and are given comprehensive powers to advise, coordinate and provide technical assistance for prevention and control of pollution of water.

4. The Act has provisions for funds, budgets, accounts and audit of the Central and State Pollution Control Boards.
5. The Act makes provisions for various penalties for the defaulters and procedure for the same.

The main regulatory bodies are the Pollution Control Boards, which have been conferred the following duties and powers:

#### **Central Pollution Control Board (CPCB):**

The board is supposed to:

- Advise the Central Government in matters related to the prevention and control of water pollution.
- Coordinate the activities of State Pollution Control Boards and provides them technical assistance and guidance.
- Organize training programmes for prevention and control of pollution.
- Organize comprehensive programmes on pollution-related issues through mass media.
- Collect, compile and publish technical and statistical data related to pollution.
- Prepare manuals for treatment and disposal of sewage and trade effluents.
- Lay down standards for water quality parameters.
- Plan nation-wide programmes for prevention, control or abatement of pollution.
- Establish and recognize laboratories for analysis of water, sewage or trade effluent sample.

The State Pollution Control Boards also have similar functions to be executed at the state level and are governed by the directions of CPCB.

1. The board advises the state government with respect to the location of any industry that might pollute a stream or a well.
2. It lays down standards for effluents and is empowered to take samples from any stream, well or trade effluent or sewage passing through an industry.
3. The State Board is empowered to take legal samples of trade effluent in accordance with the procedure laid down in the Act. The sample taken in the presence of the occupier or his agent is divided into two parts, sealed, signed by both the parties and sent for analysis to some recognized lab. If the samples do not conform to the prescribed water quality standards (crossing maximum permissible limits), then 'consent' is refused to the unit.
4. Every industry has to obtain consent from the Board (granted for a fixed duration) by applying on a prescribed proforma providing all

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technical details, along with a prescribed fee, following which analysis of the effluent is carried out.

5. The Board suggests efficient methods of utilization, treatment and disposal of trade effluents.

The Act has made detailed provisions regarding the power of the Boards to obtain information, take trade samples, restrict new outlets, restrict expansion, enter and inspect the units and sanction or refuse consent to the industry after effluent analysis.

While development is necessary, it is all the more important to prevent pollution which can jeopardize the lives of people. Installation and proper functioning of effluent treatment plants in all polluting industries is a must for checking the pollution of water and land. Despite certain weaknesses in the Act, the Water Act has ample provisions for preventing and controlling water pollution through legal measures.

Penalties include a fine of up to Rs 5000 a day for first offence and/or imprisonment from one to six years. On repeated offence, the penalty goes up to Rs 10000 a day and/or imprisonment from one to six years.

### Check Your Progress

8. When did the Environmental Protection Act come into effect?
9. When was noise pollution inserted as pollution in the Air (Prevention and Control of Pollution) Act?

## 2.5 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The first World Climate Conference was held in Geneva in 1979.
2. The World Commission on Environment and Development (WECD) was established by the UN General Assembly in 1983.
3. The activities of environment-damaging activities of TNCs are given below:
  - TNCs generate more than half of the greenhouse gases emitted by industrial sectors with the greatest impact on global warming.
  - They have virtually exclusive control of the production and use of ozone-destroying CFCs and related compounds.
4. Following are the aims of the Air (Prevention and Control of Pollution) Act 1981:
  - To provide for the prevention and control of air pollution.
  - To establish air pollution control boards for carrying out prevention and control of air pollution.
  - To assign functions and confer powers on the boards after establishment.
5. The Forest Protection Act 1927 was enacted to strengthen the law related to forests, the transit of forest produce and the duty liable on timber and other forest produce.

6. The Biodiversity Act 2002 aims to provide for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources.
7. West Bengal and Tamil Nadu are the examples of some states which have constituted Green Benches.
8. The Environmental Protection Act came into effect on 19 November 1986.
9. Noise pollution was inserted as pollution in the Air (Prevention and Control of Pollution) Act in 1987.

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## **2.6 SUMMARY**

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- In 1972, the Stockholm Conference took a step towards climate change, which is regarded as the beginning of global efforts in climate change. The first World Climate Conference held in Geneva in 1979 expressed concern about various atmospheric and other environmental issues. At the 1985 Villach conference, an international group of scientists reached a consensus on the danger of significant global warming (WMO, 1986).
- The UN conference on Human Environment was organized with the initiative of the Government of Sweden, which was held in Stockholm. The conference was attended by around 113 countries across the world. This episode was widely recognized as the beginning of modern political and public awareness of global environmental issues.
- Before the Rio-de-Janeiro conference (1992), the World Commission on Environment and Development (WECD) was established by the UN General Assembly in 1983. Chaired by Norwegian Prime Minister Gro Harlem Brundtland, the commission was outside the control of the governments and the UN system. The commission was asked to develop a 'Global agenda for change'.
- Sustainability as a physical biological-social concept was first dealt with in the Brundtland report. In fact, it elevated the concept to the level of a global ethic.
- The United Nations Conference on Environment and Sustainable Development was prompted by the Brundtland report, which called for strategies to strengthen efforts to promote sustainable and environmentally sound development. The Brundtland report defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'
- Fitting with the title of the Brundtland report, 'Our common future', many international environmental laws, conventions and treaties have been formulated for the common future of mankind. These laws are collectively referred to as international environmental law.
- The overall examination of international environmental law reveals the eight principles. They are Principle of State Responsibility, Principle of good-neighbourliness, Principles of cooperation, Principles of Sustainable

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Development, Principles of Polluter Pays, Principles of Precaution, Principles of Intergenerational Equity, and Principles of Common but differential responsibility.

- In 1992, the United Nations Conference on Environment and Development (UNCED), held at Rio de Janeiro, adopted a declaration and a global agenda for management of the environment in the next century. The declaration is known as Agenda 21, which is a massive 800-page document. It contains the Action Programme for attaining sustainable development. It also classifies several important concepts of environmental management that have immediate relevance for the marine environment.
- Environmental standards refer to restrictions on trade in commodities, which are not subjected to certain environmentally damaging limits in their production or exploitation. The environmental standards are stiffly opposed by the developing countries. These countries see the linking of environmental and trade issues as a threat to their sovereignty and their economies.
- Lack of universal environmental standards is considered a major cause of mass production technologies leading to rapid environmental degradation. In the backdrop of failing markets, the function of protecting the quality of the environment fell on the state. Since it has become evident that modernization resulted in several abnormalities like global warming, greenhouse effect and ozone depletion, it is proposed that governments impose a certain cess on resources/polluters leading to reduction of pollution levels.
- Transnational corporations (TNCs) are the most important players involved in environment- damaging activities. Along with the problems posed by TNCs, environmental resources in the developing countries also cause social conflicts in view of grave social inequalities.
- Some chemicals even at very low concentration levels in the environment pose a threat to human health and vegetation. An acceptable emission level for hazardous chemicals has, therefore, to be first defined. This has already been done by India's Central Pollution Control Board for some chemicals. Such emission level should be established for all hazardous chemicals.
- Environmental laws are the laws for protecting soil, air, water, the oceans and biodiversity, as well as laws which protect the environment as a whole. They can protect areas of land or ocean and individual species. They necessitate the conducting of environmental impact assessment (EIA) before an activity gets the approval of the enforcing agencies. They may also require people to remediate any environmental damage they cause.
- The objectives of The Environmental (Protection) Act 1986 are to provide for the protection and improvement of environment and for matters connected there with. As per this Act, the central government is empowered to take all such measures as it deems necessary for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution.



- Following are the aims of the Air (Prevention and Control of Pollution) Act 1981:
  - To provide for the prevention and control of air pollution.
  - To establish air pollution control boards for carrying out prevention and control of air pollution.
  - To assign functions and confer powers on the boards after establishment.
- Following are the aims of Water (Prevention and Control of Pollution) Act 1974:
  - To provide for the prevention and control of water pollution.
  - To maintain or restore the wholesomeness of water.
  - To establish water pollution control boards for the prevention and control of water pollution.
  - To assign suitable powers and functions for the water pollution control boards.
- Various acts and legislations, such as the Forest Protection Act, the Wildlife Protection Act, the Biodiversity Act and the SEZ Act, are intended to protect the land and minority communities.
- The Forest Protection Act 1927 was enacted to strengthen the law related to forests, the transit of forest produce and the duty liable on timber and other forest produce. This act deals with the four categories of forests, namely reserve forests, village forests, protected forests and private forests.
- The Scheduled Tribes and Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006 is an outcome of the struggle by the marginal and tribal communities of our nation to assert their rights over forestland over whom they were conventionally dependent. This Act is essential to the rights of millions of tribal and other forest dwellers in different parts of our country as it provides for the compensation of underprivileged forest rights across India, as well as both individual rights to cultivated land in forestland and community rights over common property resources.
- The Wildlife Protection Act was passed by the Indian Parliament in 1972 to protect India's wildlife. However, even during the period after the Act came into force, the number of wild animals is going down alarmingly despite of government efforts to protect them.
- The Biodiversity Act 2002 aims to provide for the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the use of biological resources. The act provides for the constitution of a National Biodiversity Authority at the national level, State Biodiversity Boards at the state levels and Biodiversity Management Committees at the local levels to implement the provisions of this Act.
- The Seeds Bill was presented in the Rajya Sabha on 9 December 2004. It was then referred to the Standing Committee on Agriculture. The Bill aims to promote the production and supply of quality seeds. It will regulate the

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quality of seeds for sale, import and export. The proposed Act replaced the Seeds Act 1966.

- The National Environmental Tribunal Act has been enacted to provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance. The National Environment Tribunal was established for effective and expeditious disposal of cases arising from such accidents, with a view to giving relief and compensation for damages to persons, property and the environment and for matters connected herewith or incidental thereto.
- Green benches are those constituted by the chief justice of the respective high courts either on their own or on directions from the chief justice of the supreme court to constitute exclusively a bench (quorum consisting of more than one judge) to deal with matters relating to environment and connected there with.
- In view of providing an international aggressive background for export, the Government of India declared the SEZ Scheme. The purpose of SEZ (special economic zone) is to help available goods and services free of tax and duties which are supported by integrated infrastructure for export manufacturing fast and prompt single window approval system and package of incentives to attract foreign and domestic investment for encouraging export-led development.
- The Energy Conservation Act 2001 provides for the legal framework, institutional arrangement and a regulatory mechanism at the Central and State level to embark upon energy efficiency drive in the country.
- The Environmental Protection Act came into force on 19 November, 1986. The Act extends to the whole of India. For the purpose of protecting and improving the quality of the environment and preventing and abating pollution, standards have been specified under Schedule I-IV of Environment (Protection) Rules, 1986, for emission of gaseous pollutants and discharge of effluents/waste water from industries.
- Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to the Water (Prevention and control of pollution) Act, the boards perform similar functions related to the improvement of air quality.
- The Water and Air Acts have also made special provisions for appeals. Under Section 28 of the Water Act and Section 31 of the Air Act, a provision for appeals has been made.
- Water (Prevention and Control of Pollution) Act provides for maintaining and restoring the wholesomeness of water by preventing and controlling its pollution.
- The Central and State Pollution Control Boards are widely represented and are given comprehensive powers to advise, coordinate and provide technical assistance for prevention and control of pollution of water.

- The State Pollution Control Boards also have similar functions to be executed at the state level and are governed by the directions of CPCB.
- While development is necessary, it is all the more important to prevent pollution which can jeopardize the lives of people.

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## 2.7 KEY TERMS

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- **Air pollution:** It is defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be harmful to human beings or any other living creatures or plants or property or environment.
- **Noise pollution:** It is defined as exposure of humans to increased levels of sound which ultimately to adverse effect in humans or living organisms.
- **Water pollution:** It is defined as such contamination of water, or such alteration of the physical, chemical or biological properties of water or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful for any other use or to aquatic plants and other organisms or animal life.

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## 2.8 SELF-ASSESSMENT QUESTIONS AND EXERCISES

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### Short-Answer Questions

1. How did the Brundtland Report promote sustainability?
2. Write a short note on Agenda 21.
3. What are environmental standards?
4. Briefly mention some of the environment-damaging activities of Transnational Corporations.
5. Write a short note on Biodiversity Act 2002.
6. Mention the salient features of the Environmental Protection Act.

### Long-Answer Questions

1. Examine the declarations and recommendations of the Stockholm Conference.
2. Discuss the eight principles of international environmental law.
3. Explain the important provisions of the Water (Prevention and Control of Pollution) Act 1974.
4. Elaborate the special provisions for appeals available under the Water and Air Act.

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## 2.9 FURTHER READING

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### NOTES

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## UNIT 3 POLLUTION

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### Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Global Environmental Problems
  - 3.2.1 Climate Change and Global Warming
- 3.3 Air and Water Pollution
- 3.4 Answers to 'Check Your Progress'
- 3.5 Summary
- 3.6 Key Terms
- 3.7 Self-Assessment Questions and Exercises
- 3.8 Further Reading

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### 3.0 INTRODUCTION

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Sustainability is derived from a discussion about the recognition of global ecological problems and globally increasing social problems of poverty as a result of economic development and its processes. This unit introduces you to the problem of environmental pollution. The word 'pollution' is not just a simple dictionary entry. It carries massive repercussions for the modern society. It stands for the evil phenomenon that has almost put our survival at risk. 'Pollution' is a term used to describe contamination of air, land or a water body by any form of material or energy that could affect the delicate ecological balance. Pollution leads to a detrimental effect on the entire biological system or it could lead to harm caused to specific living beings. The effect on the environment can be long term or short term depending upon the nature of the pollutant and the degree of infiltration into the particular environment.

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### 3.1 OBJECTIVES

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After going through this unit, you will be able to:

- Discuss the global environmental problems
- Explain the impact of climate change and global warming
- Examine the sources of air pollution and water pollution

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### 3.2 GLOBAL ENVIRONMENTAL PROBLEMS

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Sustainable development is mandatory for the protection of environment.

#### Population and its Implication

There are two aspects that affect environment: a) Population growth and b) economic development. The interaction between population growth, resource depletion/environmental damage has been debated. High population growth causes

stress on the environment, and there are thinkers, who feel that the blame has to be on economic development, industrial growth and unsustainable economic development are the matters of cause of concern especially in development.

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It can be expressed by the following equation:

$$I = P \times A \times T$$

where I = Impact of environment

P = Population

A = Affluence (consumption)

T = Technology coefficient

More people means more pressure on resources, more consumption of energy, more production of wastes including greenhouse gases – all have adverse effects on the environment. India's population has crossed the hundred crores mark. The question is whether we have devised adequate developmental programmes that can match the increase in population. If not, population factor itself would be a sufficient contribution toward degradation of environment and resource depletion.

Sustainable development is about integrational equity. But, if the future equity is of great concern, it is not legitimate to ignore the equity occurring in the present populations in different parts of the globe. Sustainability should reflect equity, environmental concerns and social responsibilities vis-à-vis population regardless of time or location.

### Limits to Growth

We will need to change attitudes, consumption patterns, manufacturing and marketing practices and get into a technological world that it is less intensive in its use of materials and energy, to be able to manage the environmental crisis. Improvement of efficiency alone is not going to be enough. Growth has been treated as an infinite variable. This is not a correct assumption. 'Earth's carrying capacity' is not seriously thought about. And such a world has to desperately try to keep pace with the environmental problems because of such incorrect assumptions.

For example, climate change (global warming), can be combated only if the world transits to a non-carbon energy economy, only after that, the limitations of the environmental concerns posed by a carbon energy economy would get lessened. The world needs an international mechanism, that not only provides incentives to all nations to live within their entitled norms (amounts), but also helps to promote a rapid transition to a non-carbon energy economy.

There is considerable scope for dematerialization and de-energization without a decrease in the living standards. This will be possible only if it is promoted through changes in the fiscal system, which supports appropriate technological improvements. This can happen if the principle of sufficiency is ignored. We will need to set a level of sufficiency, i.e., this much and not beyond it.

Sufficiency will be possible only if one day the world is prepared to reach an international agreement on limits to growth and to say, that we have fixed our level of greed and no more. Global agreement is still a distant possibility.

For sustainable use of global common systems, a separate set of policies will have to be adopted. It has to be a system that provides for the establishment of equitable entitlements or property rights to provide economic incentives to those who use this environment space in a sustainable manner and disincentives to those who use it in an unsustainable manner.

The world faces an enormous challenge in the coming years.

### **Economy**

Rate of Gross National Product (GNP) is one of the most important indicators of economic performance of any nation. Increase in GNP indicates the economic health of the country. Such an increase however, is based on high rate of consumption of natural resources, of which depletion of environmental resources is significant. Economic growth comes in conflict with issues of environmental concerns.

India had adopted the Economic Reforms Models via liberalization and globalization. There are significant advantages from this transition; however, the ecological disadvantages are required to be taken into account. Long-term ecological costs are to be taken into account. In our effort to increase the GNP, we may not like to liquidate ecological assets.

High economic growth results in high rate of extraction, transformation and utilization of non-renewable resources. It is important to also achieve good rate of regeneration of natural resources.

Economic growth cannot take place without sustaining ecological costs. Economic growth has to be environmentally sustainable. Developing countries have yet to undertake more developmental programmes and attain reasonable standards of living. Therefore, GNP must increase in these countries. Elements of resource generation and positive approach to environment have to be incorporated in developmental programmes.

### **Poverty**

In order to properly manage environment and resources, due consideration should be given to the fact that poor people directly depend upon natural resources for their livelihood. Sustainable development must address the issue of eradication of poverty which is linked with employment for women and youth and other income generation programmes.

### **Human Settlement Issues**

The environmental implications of urban development and rural development (slums) must be recognized. It will be necessary to give priority to the needs of urban as well as rural poor. The human settlement programme should concentrate on the following aspects:

1. Providing shelter to all
2. Investment in infrastructure- water, sewage and solid waste
3. Promotion of sustainable energy and transport system
4. Promotion of sustainable land use management

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## Land Resources

Land not only includes a physical entity in terms of topography, but it also includes natural resources, soil, minerals and biota. These components provide varieties of services which are essential for life support system. Land is an infinite resource. Integrated approach is necessary for the management of land.

### Forests

There should be a rational approach adopted for management of forests and forests lands. Sustainable forest development, production of forest products and forest services require institutional approach at the government level.

### 3.2.1 Climate Change and Global Warming

Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period, for at least thirty years is called climate.

The Intergovernmental Panel On Climate Change (IPCC) in 1990 and 1992 published the best available evidence about past climate changes, the greenhouse effect and recent changes in global temperature. It is observed that earth's temperature has changed considerably during the geological times. It has experienced several glacial and interglacial periods. However, during the past 10,000 years of the current interglacial period, the mean average temperature has fluctuated by  $0.51^{\circ}\text{C}$  over the 100 to 200 year period. We have relatively stable climate for thousands of years due to which we have practised agriculture and increased population. Even small changes in climatic conditions may disturb agriculture that would lead to migration of animals including humans.

Anthropogenic activities are upsetting the delicate balance that has been established between various components of the environment. Greenhouse gases have increased in the atmosphere resulting in increase in the average global temperature.

This may upset the hydrological cycle, resulting in floods and droughts in different regions of the world, causing sea level to rise, changes in agricultural productivity, famines and death of humans as well as livestock.

### Global Warming

Troposphere, the lower most layer of the atmosphere, traps heat by natural processes due to the presence of certain gases. This effect is called greenhouse effect, as it is similar to the warming effect observed in the horticultural greenhouse made of glass.

The amount of heat trapped in the atmosphere depends mostly upon the concentration of heat trapping or greenhouse gases and the length of time they stay in the atmosphere. The major greenhouse gases are carbon dioxide, ozone, methane, nitrous oxide, and water vapour.

The average global temperature is  $15^{\circ}\text{C}$ . In the absence of greenhouse gases, this temperature would have been  $18^{\circ}\text{C}$ . Therefore, greenhouse effect contributes to a temperature rise to the tune of  $33^{\circ}\text{C}$ .



Heat trapped by greenhouse gases in the atmosphere keeps the planet warm enough to allow us and other species to exist. The two predominant greenhouse gases are water vapour which is controlled by the hydrological cycle and carbon dioxide which is controlled mostly by the global carbon cycle. While the levels of water vapour in the troposphere have relatively remained constant, the levels of carbon dioxide have increased.

Other gases whose levels have increased due to human activities are methane and nitrous oxide. Deforestation has further resulted in elevated levels of carbon dioxide due to non-removal of carbon dioxide by plants through photosynthesis.

Warming or cooling by more than 2°C over the past few decades may prove to be disastrous for various ecosystems on the earth, including humans as it would alter the conditions faster than some species could adapt or migrate. Some areas will become inhabitable because of droughts or floods following rise in the average sea level.

### Greenhouse Gases

The phenomenon that worries the environmental scientists is that due to anthropogenic activities, there is an increase in the concentration of the greenhouse gases in the air that absorbs infra-red light containing heat and results in the re-radiation of much of the outgoing thermal infra-red energy, thereby increasing the average surface temperature beyond 15°C. The phenomenon is referred to as the enhanced greenhouse effect to distinguish its effect from the one that has been operating naturally for millennia.

The greenhouse gases include carbon dioxide, chlorofluorocarbons, methane and nitrous oxide. These are the greenhouse gases present in the troposphere which result in an increase in the temperature of air and earth.

### Impacts of Enhanced Greenhouse Effect

The enhanced greenhouse effect will not only cause global warming, but will also affect various other climatic and natural processes.

1. **Global temperature increase:** It is estimated that the earth's mean temperature will rise between 1.5 to 5.5 °C by 2050, if inputs of greenhouse gases continues to rise at the present rate. Even at the lower value, earth would be warmer than it has been for the past 10,000 years.
2. **Rise in sea level:** With the increase in global temperature, sea water will expand. Heating will melt the polar ice sheets and glaciers resulting in further rise in sea level. Current models indicate that an increase in the average atmospheric temperature of 3°C would raise the average global sea level by 0.2-1.5 metres over the next 50-100 years.

One metre rise in sea level will inundate low-lying areas of cities like Shanghai, Cairo, Bangkok, Sydney, Hamburg and Venice, as well as agricultural lowlands and deltas in Egypt, Bangladesh, India, China, etc. This will affect rice productivity. This will also disturb many commercially important spawning grounds, and would probably increase the frequency of storm damage to lagoons, estuaries and coral reefs.

## NOTES

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In India, the Lakshadweep Islands with a maximum height of 4 metres above the sea level is vulnerable. Some of the cities like Mumbai may be saved by heavy investment on embankments to prevent inundation.

Life of millions of people who have built homes in the deltas of Ganges, the Nile, the Mekong, the Yangtze and the Mississippi rivers will be affected, by the sea level rise.

3. **Effects on human health:** The global warming will lead to changes in the rainfall pattern in many areas, thereby affecting the distribution of vector-borne diseases like malaria, filariasis and elephantiasis.

Areas which are presently free from diseases like malaria may become the breeding ground for the vectors of such diseases. The areas likely to be affected in this manner are Ethiopia, Kenya and Indonesia. Warmer temperature and more water stagnation will favour breeding of mosquitoes, snails and some insects, which are the vectors of such diseases.

Higher temperature and humidity will increase/aggravate respiratory and skin diseases.

4. **Effects on agriculture:** There are different views regarding the effect of global warming on agriculture. It may show positive or negative effects on various types of crops in different regions of the world. Tropical and subtropical regions will be more affected since the average temperature in these regions is already on the higher side. Even a rise of 2°C may be quite harmful to crops. Soil moisture will decrease and evapo-transpiration will increase, which may drastically affect wheat and maize production.

Increase in temperature and humidity will increase pest growth like the growth of vectors for various diseases. Pests will adapt to such changes better than the crops.

To cope up with the changing situation, drought resistant, heat resistant and pest resistant varieties of crops have to be developed.

### Measures to Check Global Warming

To slow down enhanced global warming the following steps will be important:

1. Cut down the current rate of use of CFCs and fossil fuel.
2. Use energy more efficiently.
3. Shift to renewable energy resources.
4. Increase in nuclear power plants for electricity production.
5. Shift from coal to natural gas.
6. Trap and use methane as a fuel.
7. Adopt sustainable agriculture.
8. Stabilize population growth.
9. Efficiently remove carbon dioxide from smoke stacks.
10. Plant more trees.
11. Remove atmospheric carbon dioxide by utilizing photosynthetic algae.

**Check Your Progress**

1. What are the two aspects that affect environment?
2. Why is land important?
3. Name the major greenhouse gases.
4. List any two measures that can be taken to slow down enhanced global warming.

**NOTES****3.3 AIR AND WATER POLLUTION**

In recent times, the level of pollution had risen dramatically with industrialization and the rampant use of electronic goods that generate a large amount of waste that cannot be biodegraded. The harm caused to the environment disturbs the biological system and is not restricted to specific populations.

The necessity to monitor pollution levels is imperative in maintaining adequate health standards. It is also important to prevent toxic build-up of potentially dangerous matter that may threaten the health of the people living in a particular area. The effect of pollution is no longer a localized phenomenon as its effects have triggered drastic changes in the ecosystem resulting in dramatic changes that are felt in every part of the world.

**I. Air Pollution**

Air pollutants are substances that when introduced into air can cause harm to the environment including human beings. These pollutants may be biological material or chemical substances that can be seen with naked eyes or can be in an invisible form. There are many types of air pollutants that can cause a lot of damage to the environment. Apart from global warming, there are other severe damages that are caused to the ecosystem and which can harm the living beings. One such damage is the damage caused due to ozone layer depletion. The ozone molecule that contains three oxygen molecules reacts with carbon monoxide resulting in the formation of carbon dioxide and oxygen. Carbon monoxide is a highly reactive and an unstable molecule that is generated from vehicular exhaust.

The dense layer of ozone present in the upper atmosphere is responsible for filtering the harmful ultraviolet (UV) rays from the sun. The depletion of this important layer removes the protective support and exposes every living being to the harmful rays of the sun. There is no method by which ozone can be produced artificially as it is highly unstable and will react almost immediately with carbon monoxide.

When the ozone molecule absorbs the UV rays it gets converted into diatomic oxygen and a free radical.

The chlorofluorocarbon (CFC) emitted from refrigerators is another molecule that is very hazardous to the environment. The effect of electromagnetic radiation on CFC releases chlorine that is highly reactive with ozone.

**NOTES**

The chlorine molecule that is displaced will react with the ozone and lead to its depletion.

The chlorine oxide is unstable and will react with one more molecule of ozone to release two diatomic oxygen and one chlorine molecule.

This chlorine molecule will react with more ozone molecules and lead to reduction in the number of ozone molecules. On an average, every chlorine molecule takes about two years to find a stable compound with elements like hydrogen to form hydrogen chloride. During this period, it converts numerous molecules of ozone into diatomic oxygen molecules.

CFC was initially used for air conditioners and for cleaning engineering equipment. Its use is now restricted to refrigerators and increased awareness is created to reduce its use. Substances like CFC that affect the ozone layer are called ozone-depleting substances (ODS). Other ODS include sulphuric acid, freons and so on. Aerosols also contain ODS and should be used sparingly.

The evidence that the ozone layer has been depleted is ascertained using the Total Ozone Mapping Spectrometer, which helps in determining the thickness of the ozone layer. A hole in the Ozone layer is evident over the Arctic region during spring, which gets bigger during the summer and may extend over countries like Australia, New Zealand and Chile. This hole in the ozone layer exposes living beings to the harmful effects of the UV radiation and could increase the risk for certain forms of cancer, cortical cataracts and increase the production of vitamin D.

The effects of air pollution extend beyond contaminating the air that one breathes and can lead to further harm when these pollutants descend on land in the form of acid rain. The major pollutants that come down with acid rain are carbon dioxide, sulphur dioxide and nitrogen oxides. Certain industrial processes produce Sulphur dioxides but government restrictions have made the treatment of sulphur dioxide mandatory. This has considerably reduced emissions of sulphur dioxide from the industrial sources but volcanic eruptions dispel sulphur dioxide in the atmosphere. Nitrogen oxides are produced as a result of lightning strikes. When rain mixes with sulphur dioxide it gets converted into sulphuric acid that affects clothes, statues and even paint. Acid rain and its effect on the ecosystem have prompted government to take stringent action against air pollution and to find ways to reduce harmful emissions from industries.

Air pollution is a critical form of pollution that requires immediate attention and guidelines that will help curb it. The best way to fully understand this form of pollution is to identify the sources of pollution.

**Sources of Air Pollution**

Some major sources of air pollution are as follows:

**Industrial sources**

- Fossil fuel power plants generate a lot of carbon monoxide and sulphur dioxide.
- Manufacturing units contribute largely to air pollution. Many industries use incinerators to dispose their waste that leads to air pollution.

## Mobile sources

- Motor vehicles are mobile sources of air pollution as their use leads to the emission of carbon monoxide that is a potent air pollutant.
- Steam engines and airplanes are other mobile sources that contribute significantly to air pollution. Other sources of air pollution
- The use of firewood for cooking and for warmth is a cause for air pollution and further leads to indoor air pollution reaching very high levels.
- Forest fires and industrial accidents like burning of an oil reserve can lead to tremendous amount of pollution and also lead to the wastage of essential natural resources.
- Smoking of tobacco, especially within confined spaces can lead to passive smoking by other people in the room and is found to be more hazardous to the health of others as compared to the smoker himself.

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## Types of air pollution

Air pollution can be classified into the following categories depending upon certain possible reasons:

- Air pollution that is accidental
- Air polluted through industrial waste
- Air pollution related to transport
- Air pollution related to dwelling

## Accidental air pollution

The reasons for accidental air pollution are:

- Forest fires
- Accidents in petroleum mass transport vehicles
- Blasts or leakages in industries

## Industrial air pollution

The reasons for industrial air pollution are:

- Emissions from thermal power plants
- Excessive use of chemical fertilizers, pesticides in farming as well as waste disposal from pharmaceutical industries.
- Industrial wastes from industries such as steel, sugar and paper industries  
Due to cement, steel, paper and sugar industries
- Textile and textile-related industries
- Petroleum and other related industries
- Atomic units are also responsible to a certain extent

## Transport related air pollution

Pollution due to:

- All types of terrestrial transport system

- Urban transport system
- Other modes of transport

## NOTES

### Dwelling related air pollution

Pollution due to:

- Use of aerosols
- High density of population
- Waste disposal system

## II. Water Pollution

Water pollution means the contamination of water bodies with pollutants that are potentially harmful to human beings and other living beings. The unpleasant change in water may lead to changes in the colour, taste and/or even the odour of water, rendering it completely unpalatable because of the high level of toxic compounds present in the water.

Water is an essential resource that is required for many basic functions that include water for drinking, bathing, washing and cooking. A high level of contamination of water will, therefore, affect humans immensely and lead to a host of infections and disorders depending upon the level of contamination of water.

### Industries

Industries are one of the major causes behind water pollution as waste from factories may be discharged into nearby streams and rivers. This leads to pollution of the water bodies with harmful chemicals that would endanger the aquatic life. Some of the chemicals that are part of the chemical effluents from industries include lead, mercury, asbestos, sulphur and nitrous oxides. These metallic and non-metallic chemicals are hazardous to life and should be treated well before they are let down into streams. Metallic pollutants like mercury are ingested by fish and thus affect anyone who consumes the contaminated fish. The high toxic levels of such pollutants make it important to ensure that these substances are converted into safe alternatives before they are let out into the environment.

### Sewage

Sewage is another source of water pollution, especially in a developing country like India. The lack of proper sewage system that collects all the sewage from a house and drains it in a common pool for treatment is a common phenomenon in developing countries. The sewage from houses contains mostly human faeces and is completely biodegradable but when it is let out into a water body without proper treatment it can cause a lot of harm to the aquatic life. People with illnesses will pass out micro-organisms along with their stool, which will result in these harmful micro-organisms being let out in the sewerage system leading to contamination of the water body. When sewage pipes mix with water meant for drinking, it can cause diarrhoea and illness in people who drink this contaminated water.

## **Nuclear waste**

Nuclear waste is another source of water pollution as the disposed nuclear waste poses a threat to all living beings. Apart from nuclear reactors, nuclear mining also contributes to nuclear waste generation. The nuclear waste that is disposed in water bodies does not disintegrate easily. This has been witnessed in Greenland where traces of nuclear material disposed from reactors in East Europe have been found.

## **Oil**

Oil is a major contaminant that can affect marine life drastically as oil forms a layer over water and prevents contact with air. This affects fish and water plants. Oil also sticks to the feathers of birds that scoop down to pick fish and results in the bird's inability to fly. Oil contamination in seas occurs during the transfer of oil via oil pipes, from ships and other vessels. Though the effect of oil spills is localized, it can lead to drastic loss of marine life.

Marine life is also affected by inconsiderate dumping of waste by tourists who visit beaches and lakes. Styrofoam, paper, plastic, glass and even aluminium are commonly disposed in water bodies that affect fish and other aquatic life.

## **Acid rain**

Acid rain that results from air pollution contains sulphuric acid and nitric acid that could affect marine life. The sulphur dioxide and nitrous oxide from industrial emissions mix with water particles from rain and result in rain that is acidic in nature.

The increase in air pollution has also been found to affect water bodies in the form of rising water temperatures due to global warming. The increase in the concentration of carbon dioxide in the atmosphere results in the trapping of heat from the sun that leads to an increase in global temperatures. As the temperature increases, snow-capped mountains and glaciers melt leading to an increase in water volume. Moreover, there is also an increase in the water temperature that can disturb marine life.

Water pollution is a threat to the people living in developing nations as there are many water-borne diseases that spread through contaminated water. Apart from manmade causes that lead to water pollution, there are certain natural causes like volcanic eruptions that can lead to the addition of sulphur in the water body. Algal bloom is another natural water contaminant but its effect is very small and inconsiderate in comparison to other causes of water pollution.

## **Classification of Water Pollution**

The causes of water pollution may be classified into two broad categories: point sources and non-point sources.

### **Point sources**

Direct sources of water pollution like effluents from industries that are let into water bodies without being treated are called point sources. The point sources of

## **NOTES**

## NOTES

water pollution are easy to identify and easier to correct when compared with non-point sources of pollution.

When large volumes of effluents are discharged into water bodies they cause drastic changes to the quality of the water and result in complete annihilation of aquatic life in extreme cases.

Point sources of water pollution include:

- Water pollution caused by oil refinery wastewater discharge outlet
- Noise pollution resulting from jet engines
- Seismic vibrations
- Light pollution by intrusive street lights
- Thermal pollution by industrial processes
- Radio emissions from electrical devices

### Non-point sources

These sources of water pollution include sources that are multiple and which pass through various channels before they finally reach the water body. Examples of non-point sources include:

- **Rain water from busy roads:** Rain water that is collected from busy roads carries all the dirt and grime of road along with the existing pathogens. When this water is carried off into lakes it is dangerous for the people drinking water from the lake as well as the lake ecosystem.
- **Water from agricultural fields:** Water from the agricultural fields contains chemicals resulting from pesticides and manures. It affects the aquatic life owing to the toxicity of the chemicals from the pesticides. This is a non-point source of pollution as the water runs from many fields till it finally reaches the water body.
- **Emissions from various factories:** These lead to air pollution whose effects finally reach the water bodies when the emission mixes with water or snow and falls as acid rain. Some important non-point sources of water pollution include:
  - o Excess fertilizers, insecticides and herbicides from agricultural lands
  - o Oil, grease and toxic chemicals carried by the urban runoff
  - o Sediment from the construction sites, crops and forest lands
  - o Salt from irrigation practices
  - o Acid drainage from abandoned mines
  - o Bacteria and nutrients from pet wastes, livestock and defective septic systems
  - o Atmospheric deposition and hydro-modification

### III. Land Pollution

Land pollution occurs when harmful pollutants contaminate land. This form of pollution is very dangerous as it threatens to destroy the very place that one calls

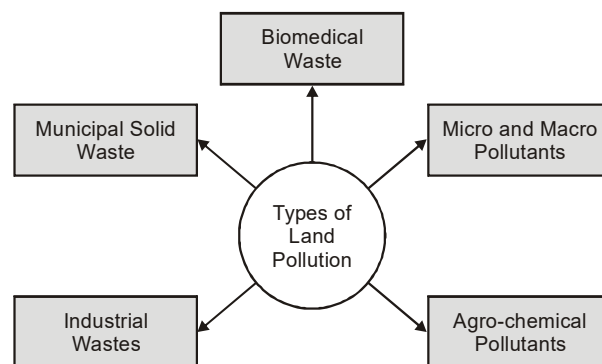


home. Contaminating the land can lead to a chain of events that includes contamination of the ground water leading to illnesses and disease among people living in the area. Unlike the other forms of pollution, land pollution is largely localized and will not spread easily. However, its effect on living beings residing in the area can be really drastic.

Development has led to the degradation of land resources and destruction of habitat of a wide variety of animal species. As more forests are cleared to make way for the construction of houses, there has been rampant reduction in forest cover. Mining for coal as well as for metals like gold has led to the destruction of many areas. Quarry mining has radically destroyed land as a habitat and it also leads to the generation of many noxious fumes that are produced as a result of quarrying. Developed countries show a higher level of land pollution when compared with developing countries and they spend a lot of funds in cleaning it.

The loss in forest cover and the vegetation exposes the soil to wind that has led to soil erosion in many areas. The top soil that is considered rich in nutrients is essential for the growth of plants and when this layer is blown away by wind, it leads to the exposure of lower layers of soil that are not as rich in nutrients like the top soil. The sand that is blown away also increases the particulate matter found in air. In order to prevent further erosion, it is essential to plant trees that will anchor the soil to the ground.

Figure 3.1 depicts the type of land pollution.



*Fig 3.1 Types of Land Pollution*

There are various sources of land pollution:

- **Macro and micro pollutants:** The pollutants that lead to drastic levels of pollution are called macro pollutants and these pollutants affect the quality of soil significantly. Micro pollutants are small quantities of pollutants that affect the environment like chemicals.
- **Agro-chemical pollutants:** The pesticides that are used to protect crops from pest attack contain chemicals that lead to the pollution of the land. These pesticides are normally sprayed onto the plants that results in a large amount of pesticides being sprayed on the land. The toxicity level of these pesticides is high and when it rains, these chemicals either get mixed with ground water or are washed away to a water body.

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## NOTES

- **Industrial wastes:** Industries generate a lot of effluents and waste that may be covered and stored in pits or dumped in landfills. The chemicals present in these effluents seep into the ground and either enter the groundwater or remain in the soil. It has been found that nearly twenty million hectares of crops in China are affected by heavy metal poisoning and are destroyed every year.
- **Municipal solid waste:** The household waste that is produced by every house amounts to a large quantity that is very difficult to dispose. Kitchen waste that includes bio-degradable waste like vegetable peels can be used as manure. However, plastics, glass and aluminium will not degrade and should be disposed off carefully. Plastics tend to clog drains and get attached to the roots of plants preventing them from absorbing water resulting in the destruction of crops. The solid waste that is dumped in landfills generates a large amount of methane gas and carbon dioxide that are potentially harmful.
- **Biomedical waste:** Hospital wastes are dangerous as they could be laden with pathogenic micro-organisms that may lead to infections. It is extremely important to destroy bio-medical wastes carefully to ensure that there is no transmission of infections. Harmful wastes that are contaminated with infectious blood and other specimen should be destroyed in an incinerator to prevent contact. Needles should be destroyed carefully so that they do not harm another individual.

When hospital waste is dumped without segregation it can lead to land pollution, which is extremely risky and may lead to illness among people who come in contact.

#### Check Your Progress

5. What is responsible for filtering the harmful UV rays from the sun?
6. How is CFC harmful for the environment?
7. How does land pollution occur?

### 3.4 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The two aspects that affect environment are population growth and economic development.
2. Land is important because it not only includes a physical entity in terms of topography, but also includes natural resources, soil, minerals and biota. These components provide varieties of services which are essential for life support system.
3. The major greenhouse gases are carbon dioxide, ozone, methane, nitrous oxide, and water vapour.
4. To slow down enhanced global warming the following steps will be important:
  - What are the two aspects that affect environment?
  - Why is land important?

- Name the major greenhouse gases.
  - List any two measures that can be taken to slow down enhanced global
    - (i) cut down the current rate of use of CFCs and fossil fuel.
    - (ii) use energy more efficiently.
5. The dense layer of ozone present in the upper atmosphere is responsible for filtering the harmful ultraviolet (UV) rays from the sun.
  6. The chlorofluorocarbon (CFC) emitted from refrigerators is another molecule that is very hazardous to the environment. The effect of electromagnetic radiation on CFC releases chlorine that is highly reactive with ozone.
  7. Land pollution occurs when harmful pollutants contaminate land. This form of pollution is very dangerous as it threatens to destroy the very place that one calls home.

## NOTES

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### 3.5 SUMMARY

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- There are two aspects that affect environment: a) Population growth and b) economic development.
- Rate of Gross National Product (GNP) is one of the most important indicators of economic performance of any nation.
- Increase in GNP indicates the economic health of the country. Such an increase however, is based on high rate of consumption of natural resources, of which depletion of environmental resources is significant.
- In order to properly manage environment and resources, due consideration should be given to the fact that poor people directly depend upon natural resources for their livelihood.
- Land not only includes a physical entity in terms of topography, but it also includes natural resources, soil, minerals and biota.
- Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period, for at least thirty years is called climate.
- Anthropogenic activities are upsetting the delicate balance that has been established between various components of the environment. Greenhouse gases have increased in the atmosphere resulting in increase in the average global temperature.
- Troposphere, the lower most layer of the atmosphere, traps heat by natural processes due to the presence of certain gases. This effect is called greenhouse effect, as it is similar to the warming effect observed in the horticultural greenhouse made of glass.
- Warming or cooling by more than 2°C over the past few decades may prove to be disastrous for various ecosystems on the earth, including humans as it would alter the conditions faster than some species could adapt or migrate.

## NOTES

- The greenhouse gases include carbon dioxide, chlorofluorocarbons, methane and nitrous oxide. These are the greenhouse gases present in the troposphere which result in an increase in the temperature of air and earth.
- There are three main types of pollution—air pollution, water pollution and land pollution.
- The dense layer of ozone present in the upper atmosphere is responsible for filtering the harmful ultraviolet (UV) rays from the sun. The depletion of this important layer removes the protective support and exposes living beings to the harmful rays of the sun. Unfortunately, intense air pollution and the use of ozone depleting substances have created a hole in the ozone layer.
- The effects of air pollution extend beyond contaminating the air that one breathes and can lead to further harm when these pollutants descend on land in the form of acid rain. Rain water mixes with sulphur dioxide and nitrous oxide in the air to give rise to acid rain.
- Major sources of air pollution are as follows:
  - o Industrial sources like fossil fuel used in thermal power plants
  - o Mobile sources like motor vehicles
  - o Other sources of air pollution like the use of firewood for cooking
- Water is an essential resource that is required for drinking, bathing, washing and for cooking. Contamination of water therefore affects humans immensely. Some major sources of water pollution are: sewage, nuclear waste, oil and acid rain.
- Water pollution is caused due to point sources and non-point sources of Pollution contamination.
  - o The point sources of water pollution are easy to identify like large volumes of effluents being discharged into water.
  - o Non-point sources of water pollution include sources that are multiple and that pass through various channels before they finally reach the water body like rain water from busy roads.
- Contaminating the land can lead to a chain of events that includes contamination of the ground water leading to illnesses and disease among people living in the area. Main causes of land pollution are: macro pollutants, micro pollutants, agro-chemical pollutants, industrial waste, municipal waste and bio-medical waste.

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## 3.6 KEY TERMS

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- **Gross National Product:** It is the total value of all finished goods and services produced by a country's citizens in a given financial year, irrespective of their location.
- **Acid Rain:** It refers to rain or rain or any other form of precipitation that is unusually acidic as a result of environmental pollution.

- **Fossil Fuel:** These are buried flammable geologic deposits of organic substances such as dead plants and animals that got deposited under several thousand feet of silt.

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### 3.7 SELF-ASSESSMENT QUESTIONS AND EXERCISES

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### NOTES

#### Short-Answer Questions

1. What should be the focus of human settlement programmes?
2. Briefly mention the effects of climate change on the environment.
3. Write a short note on the greenhouse effect.
4. How does CFC cause ozone depletion?
5. How is water pollution a big threat to the people living in developing countries?
6. List some measures that can help overcome the problem of water pollution.

#### Long-Answer Questions

1. Examine the impact of enhanced greenhouse effect.
2. Explain the major sources of air pollution.
3. Describe the sources of land pollution.

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### 3.8 FURTHER READING

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# UNIT 4 BUSINESS AND ENVIRONMENT

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## NOTES

### Structure

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Environmental Management System
  - 4.2.1 Business and Standards
- 4.3 Environmental Clearance for Establishing and Operating Industries in India
- 4.4 Waste Management
  - 4.4.1 Hazardous Waste Management
- 4.5 Business, Industry and Environment
- 4.6 Answers to 'Check Your Progress'
- 4.7 Summary
- 4.8 Key Terms
- 4.9 Self-Assessment Questions and Exercises
- 4.10 Further Reading

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## 4.0 INTRODUCTION

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Environmental management system helps in conservation of natural resources and protection of habitats. Various approaches and tools can be adopted at the management level to bring about significant changes. An environment management system (EMS) is a systematic approach for incorporating environmental goals and priorities into routine operations and managing environmental programs in a planned manner. This unit will discuss the importance of EMS and the practice of waste management. The importance of social responsibility will also be explained.

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## 4.1 OBJECTIVES

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After going through this unit, you will be able to:

- Explain the importance of Environment management system
- Examine the concept of waste management and hazardous waste management
- Discuss the importance of social responsibility of business

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## 4.2 ENVIRONMENTAL MANAGEMENT SYSTEM

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Environmental management offers research and opinions on use and conservation of natural resources, protection of habitats and control of hazards, spanning the field of applied ecology without regard to traditional disciplinary boundaries.

The environmental management activities at a firm are guided by the selection of an environmental strategy. This strategy drives alignment of the environmental

management systems, programs, and tools that will be used. Environmental strategies can be said to occupy four levels of sustainability: compliant, market driven, engaged, and shaping the future.

**NOTES**

**Four Strategy Levels**

- **Compliant:** A firm decides it will be in compliance with all environmental, health, and safety regulations. This is the minimum level of environmental strategy a firm can adopt.
- **Market-driven:** A firm responds not only to regulatory requirements, but also reacts to its customers' environmental expectations by providing leading product/service and operational performance.
- **Engaged:** A firm is not only in compliance, but also understands its environmental market opportunities and proactively uses that knowledge to create engagements with the value chain and other stakeholders to identify opportunities faster.
- **Shaping the future:** A firm develops products and services for current and future market conditions, addressing unmet societal needs by proactively integrating economic growth, environmental health and safety, and social well-being into its operations and business practices.

(Source: Adapted from Fava, J. et. al., 1998)

The relationship of business implications (e.g. efficiency, compliance, liability reduction, cost savings or avoidance, and revenue generation) to environmental strategy is shown in Figure 4.1. As a firm moves from a compliant strategy to a more sustainable strategy, different implications result.

	Business Implication		
	Costs	Savings	Revenue
Shape the Future			
Engaged			
Market Driven			
Compliant			

**Fig. 4.1** Business Implication on the Strategy Implemented

(Adapted from Fava et al, 2001)

A compliant strategy, for example, is often viewed as a cost and often includes only strategic elements aimed at meeting the legal requirements as efficiently as possible. In a market-driven strategy, a firm has integrated pollution prevention and customer/consumer or reactive market considerations into the design of its products or processes, which results in cost savings or cost avoidance. On the other end, *shaping the future* strategy may generate revenue by viewing the



environment from a strategic perspective to identify new business opportunities, and greener products.

### **Strategy is Essential but Not Sufficient; Businesses Also Need Environmental Management Systems, Programmes, and Tools**

Organizations use various approaches and tools to integrate environmental considerations into their everyday decision processes. Environmental approaches and tools can be described as operating at a management system level, a program level, or a tool level.

Environmental management systems are broad, flexible frameworks for managing an organization's environment-related activities. They are usually tailored to a specific organization's environmental strategy, business model, and environmental responsibilities. Management systems addressing similar needs can vary significantly from one organization to another, based on differentiation arising from their respective business models and environmental strategies.

Programmes are a level below management systems and are often used to carry out the strategic intent of the organization. Programmes generally have a higher degree of specificity, and common program elements often appear among organizations in the same industrial sector.

Tools are used to support environmental systems and programs. Environmental tools are highly specialized and are often created with rigorous scientific methodology.

#### **A. Water Resource Management**

Community-based water resource management has been in limelight for quite some time now. Several examples can be quoted nationally and internationally where community members have joined hands to manage this precious resource for its sustainable use. A notable example from India is that of Dr Rajendra Singh who won the Magsaysay Award in 2001 for his exemplary efforts in community development and water conservation and management in the state of Rajasthan.

Water resources should be protected because of the following reasons:

- To ensure the availability of fresh, clean drinking water for future generations
- To conserve energy, which is otherwise used for the pumping, delivery and treatment of water
- To preserve fresh water habitats for local wildlife and migrating waterfowl
- To reduce the need to build new dams and other water diversion infrastructures
- To reduce per capita water consumption

However, the present problem is not the lack of availability of water. The issues are more of lack of optimal management, better distribution mechanism and reduction of leakage. These issues have to be treated with utmost urgency, or else the nation will have to resort to expensive solutions or live with the burden of hampered growth.

### **NOTES**

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Some optimum solutions include the following innovative and futuristic management techniques:

- Minimum use of water
- Water recycling
- Reusing waste water for industrial uses
- Ensuring a higher degree of efficiency in the management of water use in irrigation
- Desalination in coastal areas
- Recharging of the groundwater level by means of artificial aquifer recharging and recovery

### **B. Forest Resource Management**

Forest resource management involves the sustainable management of forests by using comprehensive social, economic and environmental goals. Forests are important ecosystem resources, and several attempts have been made to protect them to provide a sustainable resource for the future generations.

The Chipko Movement is one of the most famous and commendable efforts in the area of protecting forests. The concept of people's participation in management of forests is not new to India. The country historically has great traditions of protecting and managing forests as common resources. Every village, hamlet and community ensured that the utilization of natural resources including forests did not exceed the ecological carrying capacity. The economic and political colonization of the country adversely affected the traditions of conservation of sustainable utilization of resources.

The forests and the people, which grew under the mutually beneficial relationships, suffered together, as the growing population put an ever-increasing demands on the resources. The forest wealth gradually depleted and the people & forests were caught in the vicious circle of ecological and economic deprivation. Post independence, forestry practices also continued to neglect the need for forest conservation practices and people's involvement in the process. For nearly four decades after independence, the process of commercial exploitation and degradation of the forest continued.

During the eighties, the satellite imageries sounded the alarm bell by pointing to the fact that less than 14 per cent of the country's area was under forest cover as against the desired figure of 33 per cent. Good tree cover was found in few isolated patches only and large parts of the forest areas were suffering from various degrees of degradation.

These warning signs of impending ecological crises led to serious review of the approaches to the management conservation and utilization of forests. Although the 1952 forest policy aimed at forest coverage of one-third of the total land area of the country, due to various constraints, no efforts were made to attain this. Diversion of vast stretches of forestland was made for non-forest use; the biological diversity was considerably affected as also the good tree cover and the forest area.

### **Joint forest management**

The importance of forests for the ecological and economic stability of the country was realized by conservationists, foresters, and the government, which necessitated the re-examination of the policy, laying emphasis on the conservation and sustainable utilization of our forest resources.

The National Forest policy of 1988 brought about significant changes in the existing forest management policies and practices. One of the main recommendations was the involvement of people in forest conservation and management as the major means of putting off the impending ecological crises and providing the benefits of these efforts directly to the people. It was realized that conservation and proper management of forests was not possible without active participation of the local people. Efforts were accordingly initiated in the seventies to involve local people in this task. This approach of involving the local people in the protection and management of forests is commonly referred to as joint forest management (JFM).

### **C. Energy Resource Management**

Energy resource management can be defined as the process of monitoring, controlling and conserving energy in any setting. India is currently facing a problem of inadequate energy. This is especially true of several villages in the country where electricity remains a mere dream. It is in such a scenario that corporate as well as non-governmental organizations are undertaking monumental efforts to popularize the harnessing of solar energy. For instance, in rural Odisha, solar power has ensured that the fates of many villages has undergone rapid transformation—homes are lit after dark, fields are irrigated using solar power and mobile telephone towers keep the hinterlands connected.

The concept of energy resource management is still in its nascent stage in India as against the ever-increasing energy requirements of the rapidly growing economy. The country produces about 2.4 per cent of its energy needs and consumes about 3.4 per cent. It is ranked eleventh on the production list and sixth on the consumption list. These numbers have increased by 50 per cent in the last few decades.

Poor communities residing in far flung areas lack access to energy resources that are available to their urban counter parts. In such scenario making energy accessible to them becomes one of the challenging and ethical responsibilities of the state and other counterparts engaged in development activities.

### **D. Biodiversity Resource Management**

Biodiversity refers to variation of life forms within a given species, ecosystem, biome, or an entire planet. It can be defined as the variety and diversity that exist among living organisms of all species, genera and ecosystems. The Convention on Biological Diversity defines biodiversity as ‘the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems’.

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The biodiversity that this country has been blessed with is evident in the fact that it plays host to two of the world's eighteen 'biodiversity hotspots' – located in the Western Ghats and the eastern Himalayas. The forest cover in these areas is very dense, diverse and replete with pristine beauty. According to government reports, the country is estimated to have more than of 45,000 species of plants and 81,000 species of animals. These represent 7 per cent of the world's flora and 6.5 per cent of its fauna. This has gone up to 49,219 species of plants and 81,251 species of animals, representing 12.5 per cent and 6.6 per cent of the world's flora and fauna respectively. Furthermore, the Thar Desert and the Himalayas are two regions rich in biodiversity in India. The Chilika Lake, in Odisha, is also an important wetland area of global importance that is rich in biodiversity.

The last century has seen considerable damage being done to the biodiversity of the planet, caused by factors such as the following:

- Increasing level of human population
- Increasing levels of consumption
- Decreasing efficiency of use of resources

Trade in wildlife, such as the elephant tusk, rhino horn, snake skin and crocodile hide, has led many species to the brink of extinction. This has caused a loss of balance to the food chain, thereby affecting both flora and fauna.

To solve this problem, the government has set up biosphere reserves in different parts of the country to help conserve the biological diversity prevalent in different ecosystems. Some of these have been set up in the Nilgiris, Nicobar, Manas, Sunderbans and Dibru Saikhowa. NGOs are also involved to create awareness.

### 4.2.1 Business and Standards

Now-a-days environment protection has become a point of concern for the commercial establishments or business houses and the rules and regulations are becoming more and more stringent or severe. With regard to survival and prosperity, firms must look ahead to potential legislation by the execution and implementation of EMSs, if they want to sustain and grow.

An environment management system (EMS) is a systematic approach for incorporating environmental goals and priorities into routine operations and managing environmental programs in a planned manner. It is a set of processes and practices that enable an organization to reduce its environmental impacts and helps in achieving environmental goals through consistent control of its operations.

An EMS is regarded as an important management tool that aids a business in understanding recognition of and its jurisdiction over, ecological influences. It is structured in such a manner that it can be applied to any enterprise or company, big or small, public or private, and to any industry sector. It may be implemented to an individual site, to a section operating at various sites, or to an entire company. This flexibility may be quite helpful to those companies which are operating at diverse levels and the related environmental impacts may differ broadly. However, there is a risk of undermining the credibility of these enterprises that do not put an

EMS into practice at all the relevant levels. The key requirements of an EMS include:

- Senior management should be included in the commitment as this has significant lawful repercussions in some jurisdictions;
- Legal and other requirements must be addressed;
- Interested parties' concerns must be reflected in the development of objectives and targets; and
- A commitment must be made to continuous improvement.

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### **Business Interests**

'Environment' has become a significant factor in the decision-making procedure of organizations or companies worldwide. The complexity of environmental systems is increasing and it is interconnected. The old and traditional methods of addressing environmental issues in an ad-hoc, reactive, end-of-pipe manner are turning out to be ineffective and inefficient. The global market is expanding and so is the competition within them and as a result environmental laws and regulations are forcing new standards for companies and businesses in all the regions of the world. Good quality environmental performance is not just a moral or legal responsibility. It makes excellent business sense. Increasing efficiency and wasting fewer resources requires pollution reduction measures to be implemented effectively. A more productive workforce is the result of enhanced health and safety measures and conditions. Further, the markets can be expanded and sales be increased only if the goods and services supplied are environment friendly. Overall, the practice of good management of the environment helps the organizations to become more competitive. The ISO 14001 certification may reap many awards for an organization/company, which may prove to be a financial boon to the organization in the long run. Seven potential rewards have been mentioned below and the list could be further expanded.

- First, many firms hope that regulatory agencies such as the EPA would treat them more favourably in return for obtaining the ISO 14001 certification (and the actions required to do so). For instance, establishments are eager to have reduced rigidity in filing, or reduced supervision, or even reduced severe restrictions for the infringement of environmental laws.
- A second advantage to businesses is that a considerable number of citizens can be influenced in their purchasing decisions. Getting ISO 14000 certification is most desirable for companies to show their environmental stewardship and accountability to the public.
- Third, for attracting investors to the business organization, ISO 14000 certification is an effective method. The increasing number of individual investors as along with investment managers and managers of mutual funds look for environmentally responsible businesses.
- Fourth, lot of money may be saved on the insurance premiums that a company has to pay often. For instance, there are some insurance firms which give minimized rates on insurance to cover accidental contamination releases if the insured business has successfully implemented an EMS.

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- Fifth, actions started in the process of applying the EMS are liable to lessen the probability of poisonous slicks, jeopardizing workers and associates of the community.
- Sixth, ISO 14001 may aid a corporation in obtaining loans and safeguarding it from allegations of investor fraud because financial establishments are responsive to environmental hazards and their effect on security.
- Seventh, an organization may understand internal cost savings as a result of reduced energy use, waste reduction, use of fewer toxic chemicals and recycling due to the implementation of an EMS.

### **Voluntary Standards**

The ISO 14001 originated at a time when several national and international standards were either already in use or under development. In early 1992, a British standard, BS 7750, was published. It was pilot tested in the United Kingdom and revised in early 1994. In late 1994, the European Union, through the European Commission, adopted the Eco Management and Audit Regulation. The Eco-Management and Audit Scheme (EMAS) were included in this regulation, which recognized EMS specifications for companies doing business in the European Union. Some organizations worldwide, including the United States, adopted the British BS 7750 standards, the European Union's EMAS standards, or both. The original draft language in ISO 14001 has its roots in the BS 7750, as well as other national standards.

### **ISO 14001**

As an international standard, it is most widely adopted in the UK with about 1400 certified companies. The British Standard BS 7750 was replaced by it in the year 1996. The main aim of ISO 14001 is to encourage and ascertain continual enhancement of environmental performance, prevention of pollution and compliance with legal and other requirements. Target requirements are not specified by the standard but it provides a framework for better management practices.

An accredited third party carries out the certification through an audit of the system, which is usually followed by surveillance checks. There has been a recent update in the standard to incorporate further compatibility with the ISO 9001:2000 quality standard. The present standard of ISO 14001 is ISO 14001: 2004.

### **EMAS (European Eco-Management and Audit Scheme)**

The EMAS first came into existence in the UK in the year 1995. There are about 75 companies certified to EMAS in the UK. EMAS is more extensively used in Europe. The aims of EMAS and ISO 14001 are alike with an added objective of increasing public environmental reporting in the EMAS. The verification of EMAS and ISO 14001 are carried out in the same manner but there is an added prerequisite for the publication of an Environmental Statement giving the detailed information of the company's progress and performance in accomplishing the objectives and targets.

## **BS 8555**

It is a six-stage procedure for achieving EMS certification. This standard permits an enterprise or business to attain certification at its own pace and still receive acknowledgement in each phase through an external verification audit.

## **ISO 14000**

ISO 14000 is a series of international standards on environmental management. It provides a framework for the development of both the system and the supporting audit program. The key objective of the ISO 14000 series of norms is ‘to promote more effective and efficient environmental management in enterprises or organizations and to offer beneficial and practical tools for collecting, interpreting and communicating environmentally relevant information’.

### **The ISO 14000 Family**

The ISO 14000 family comprises two main standards:

1. ISO 14001:2004—It provides requirements for an EMS.
2. ISO 14004: 2004—It gives the general EMS guidelines.

The most notable of the ISO 14000 family is the ISO 14001 standard that signifies the essential set of standards to design and implement, and is used by organizations for an effective environmental management system. The ISO 14004 is another standard in this series, which provides further guidelines for a better environmental management system, and there are other specific standards that deal with particular features of environmental administration.

The earlier environmental regulations were initiated with command and control approaches, and later substituted with ones built on market mechanisms. The ISO 14000 was based on a voluntary approach to environmental regulation. The ISO 14001 standard has several similar features to its predecessor ISO 9000, the international standard of quality management (Jackson 1997). It functioned as a model for its internal structure (National Academy Press 1999) and both of them can be applied simultaneously. Like ISO 9000, ISO 14000 acts as an internal management tool as well as a method of representing any company’s environmental commitment to its customers and clients.

Organizations constructed their own EMS systems prior to the development of the ISO 14000 series, but the comparisons between environmental effects became challenging and hence the universal ISO 14000 series came into existence. The definition of EMS, as given by ISO is: ‘Part of the overall management system, comprising of organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving and maintaining the environmental policy’.

The ISO 14000 family, associated with environmental management and auditing standards is not concerned with environmental performance and this difference is fundamental. A management standard establishes the organizational requirements to meet its goals, rather than being concerned with procedures of performance like power efficiency and discharge.

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More than 20 standards, guides and other publications are comprised in the ISO 14000 family that is associated with an assortment of subjects like forest administration and life process evaluation. Given below is an example of the ISO 14000 series.

ISO 14001	Environmental Management Systems - Specification With Guidance for Use
ISO 14004	Environmental Management Systems - General Guidelines on Principles, Systems and Supporting Techniques
ISO 14010	Guidelines for Environmental Auditing - General Principles of Environmental Auditing
ISO 14011	Guidelines for Environmental Auditing - Audit procedures Part 1: Auditing of Environmental Management System
ISO 14012	Guidelines for Environmental Auditing - Qualification Criteria for Environmental Auditors

### The ISO 14001 Standard

A significant principle of ISO 14001 administers environmental management systems, where businesses characterize their own purposes on the basis of their preferred concerns, like the demands of regulators, consumers, various communities, lenders or ecological groups. This norm provides a rough draft in which strategies are built so that they achieve objectives and churn out information concerning the meeting of targets.

An EMS that fulfills the prerequisites of ISO 14001:2004 is a management tool which facilitates a firm in:

- Identification and control of the environmental effect of its actions, goods and services.
- Enriching its environmental accomplishments persistently.
- Implementation and achievement of ecological goals.

In the latter part of 2001, around 32,000 establishments all over the world had got ISO 14001 accreditation. A significant advantage of implementing ISO 14001 is that the stakeholders get the encouragement that the company's environmental assertions are legitimate.

The ISO 14001 norms are thought to be flexible and anticipated to be of significant worth in several situations. However, it is implemented most readily in large establishments or companies, who have a formal management system in place and they possess the expertise and resources for integrating environmental issues into that system. On the other hand, the principles are formulated in a manner that they can be applied to small businesses and even non-business organizations. Generally, implementation of the other standards is possible if there is conformance with one of the international standards. For example, it is easier for an organization to satisfy the requirements of EMAS (the European Eco-Management and Audit Scheme), once it has implemented ISO 14001.

### ISO 14000 in the US

Different US government agencies have been enthusiastically following the advancement of the ISO 14000 series standards. In addition, they have also given



inputs in various contexts. For example, the EPA, the Department of Defense, and the Department of Energy provide representatives to the U.S. Technical Advisory Group (U.S. TAG). The U.S. TAG, in turn, provides input to TC 207, the ISO technical committee responsible for the ISO 14000 series.

There is an extremely developed regulatory system in the United States designed for the protection of environment. The EPA, in collaboration with state-level counterparts, imposes numerous environmental protection statutes like the Clean Water Act; the Clean Air Act; Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); and the Toxic Substance Control Act. The ISO 14000 series is not viewed as a substitute for regulation and statutes in the United States, unlike a developing nation, where a broad regulatory scheme may be completely missing in the area of environmental protection. However, application of an EMS by an ISO 14001 certified company does not have the possibility to improve that compliance rate of the establishment with the state and federal environmental law.

### **ISO in Europe**

European Union countries are at the forefront of those being registered for ISO 14000 standard. Fueled by ISO 9000's success and an enhanced eco-awareness by the worldwide community, ISO 14000 achieved worldwide recognition in a remarkably short period. The reaction from EU companies has been particularly astounding, with more than half of the nearly 6,700 ISO 14001 registrations worldwide coming from EU countries. The United Kingdom leads the EU countries with about 1,000 ISO 14001 registered sites; Germany is next with about 950. Japan is the only country to surpass these two, with more than 1,200 sites registered. When looking at the numbers of registered sites in the European Union, it is important to remember the size of each country.

### **International Chamber of Commerce Principles**

Sixteen principles have been proposed by the International Chamber of Commerce (ICC), which aims at helping different establishments worldwide and improving their performance, for sustainable development. An earlier analysis demonstrated that these principles cover many significant issues and this is the reason for their selection. According to the ICC (The Business Charter for Sustainable Development, 1999), these principles have been set up after several remarks/comments were incorporated, referring the extension of these principles to the municipal administration.

### **Principles of Environmental Management According to ICC**

- i. **Corporate priority:** To identify environmental management as the highest corporate priority and consider it to be a crucial determinant for sustainable development; to establish programs, policies and practices for conducting operations in a sustainable and environment friendly manner.
- ii. **Integrated management:** To incorporate these policies, programs and practices entirely into all businesses as an integral and significant element of management in all its functions or purposes.

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- iii. **Process of improvement:** To strive continuously for improving corporate guiding principles, programmes and ecological performance, keeping in mind the technical enhancements/advancements/creations, technological know-how, customer requirements and society outlook, with lawful protocols as an initiating point; and application of an identical environmental criteria globally.
- iv. **Staff education:** To educate, coach and inspire the workforce to carry on with their operations in an environmentally liable way.
- v. **Before hand evaluation:** To measure or estimate a variety of environmental effects before the start of a new assignment or endeavor and prior to retracting from a facility or going off a position.
- vi. **Goods and services:** To manufacture and offer goods or services that are reliable to use and have no or minimal environmental impacts; that are efficient in energy consumption and using natural resources; and that can be recycled, reused or disposed of safely.
- vii. **Customer advice:** To advise and educate customers, distributors and public about the safe storage, transportation, use and disposal of products; and to implement similar considerations for services.
- viii. **Facilities and operations:** To design, develop and operate facilities and conduct activities taking into account the efficient usage of energy and resources, the long-term use of renewable resources, the playing down of unfavourable environmental influence and waste generation and the secure and accountable discarding of left over litter.
- ix. **Research:** To carry out and sponsor researches on the ecological effects of raw materials, yield, practices, discharge and litter related to the venture and for the lessening of such unfavorable influences.
- x. **Precautionary tactic:** To alter the processes or procedures for manufacturing, marketing or using the goods or services or carrying out activities, in tune with technological and scientific awareness, to prevent extreme, beyond repair and irrevocable environmental squalor.
- xi. **Contractors and suppliers:** To adopt these principles by suppliers and contractors who are working or performing on behalf of the venture, motivating and necessitating enhancement in their practices for making them consistent with the principles of the company or enterprise
- xii. **Emergency preparedness:** To develop and maintain crisis vigilance strategies in union with the crisis assistance, pertinent agencies and the domestic community, identifying possible trans-boundary effects, where significant hazards exist.
- xiii. **Transfer of technology:** To contribute in the transfer of environmentally safe technology and management methods across the industrial and public sectors.
- xiv. **Contribute to the common effort:** To contribute in developing community policy to companies, legislative and inter legislative programmes and

educational proposals, for increasing environmental responsiveness and safety.

- xv. **Honesty to apprehensions:** To promote forthrightness and discourse with workers and the public, looking forward to and responding to their queries related to probable risks and effects of processes, products, trash or services, as well as those of trans-boundary or worldwide implication.
- xvi. **Conformity and reporting:** To gauge environmental accomplishment; to carry on timely environmental reviews and appraisals of conformity with organization requisites, legal compulsions and other principles and to provide appropriate information periodically to the Board of Directors, shareholders, employees, the authorities and the public.

These principles can be interpreted and implemented in the public administration as the national, state and municipal administrations are public organizations having a structure similar to business companies.

### ISO in the Developing World

The potential significance of the ISO 14000 series was recognized quite early by the ISO member bodies in several developing nations, and they have been playing a significant role in the development of standard procedures. This contribution, integrated with TC 207's efforts for meeting similar concerns of Small and Medium Sized Enterprises (SMEs), has had significant effects on the entire shape and focus of the core EMS standards in the ISO 14000 series.

TC 207 has taken into account the specific requirements of these groups and incorporated them into the core EMS documents, due to the participation in TC 207 and its subcommittees by the representatives of these groups, and through consultation with other experts. However, to be actually responsive to the requirements of SMEs and developing nations, TC 207 shall continue to listen, and to motivate participation of those who want their voices to be heard, but do not have the resources available. This is mainly important in the existing implementation or application phase of the ISO 14000 EMS and environmental auditing standards.

TC 207 has motivated the developing nations; but deficient in its financial resources, it has had to depend entirely on the support of many nations that have donated funds to support this participation by recognizing beyond the significance of wide contribution from developing nations in the TC. These donations have been coordinated by ISO/DEVCO (Policy Development Committee).

DEVCO is also involved in facilitating the application of these standards in developing nations. It recognizes that nations must have a standardization infrastructure in place, and clear and precise information should be accessible to the potential users. DEVCO is working in collaboration with TC 207 for developing a handbook on environmental management, and has started a seminar program for the capacity building of developing nations to use and support the standards.

Meanwhile, TC 207's SC 1 has launched an initiative to support the TC to meet the needs of SMEs worldwide in a better way, as they apply and use the

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ISO 14001 and ISO 14004 standards. A project team has been assigned the task of collecting information on the requirements of the SMEs in this area by the SC 1.

### **Voluntary Standards and the GATT/WTO**

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ISO 14000 is focused, at least in part, on easing the way for international commerce. It is, thus, natural to ask how it would relate to the World Trade Organization and the agreements that resulted from the Uruguay Round of trade negotiations. The divergent standards of environmental management or codes of practice are a point of concern that may generate non-tariff obstacles to trade. Hence, it has led to a lot of interest in harmonization.

Two issues have risen up with respect to ISO 14000, in context of the WTO agreement. The primary issue relates to the extent to which ISO 14000 interacts with, or is affected by the WTO agreements. The government activities are the main areas for regulation by the WTO. Basically, the objective of international trade agreements is to treat imports akin to domestic products and services (national treatment), and to preclude discrimination by authorities/government contrary to purchase of products or services for particular countries (non-discrimination).

The ISO 14000 standards have been formulated as standards for corporations and not nations. The question of whether companies adopt ISO 14000 or not, would not be a question of concern under the WTO rules, unless the government of a country requires its importers to adopt the ISO 14000 standard. The two mechanisms of the WTO agreements are appropriate: the Agreement on Technical Business to Trade (TBT) and the Code of Good Practice. All restrictions on exports and imports are based on product norms and technological requisites and the details of how such limitations should be prepared, adopted and prepared come under the purview of the TBT Agreement. Technical regulations require the product's features (or the measures and techniques of production, if they have any impact on the ultimate product's features) should fulfill specific requirements. A scientific directive may necessitate, for instance, that all vehicles made abroad must be fixed with catalytic converters, or an item should be labelled in a particular manner, or must go through several trials or test prior to their entry into the country. Standards may be described as non-mandatory details of a product's characteristics (or of the procedures and production methods), quantified by a recognized body, such as a body that sets standards or an international agreement.

Eco-labels may be also considered as standards. ISO 14000 has been formulated principally to be useful to establishments or companies in relation to their suppliers and customers. It is an entirely business decision whether establishments or companies choose to use ISO 14000 or not, which is centered on the normal business criteria. The WTO rules do not deal with these matters, except through the Code of Good Practice.

Finally, ISO 14000 deals with management systems. The ISO 14000 requirements do not comprise specific performance objectives that establishments or companies will set. The performance requirement of a company is also a business decision and does not come under the purview of the WTO rules. These are entirely different circumstances as compared to a situation where the government

lays performance goals for importing goods into the country, where the regular WTO rules of national treatment and non-discrimination are bound to apply. The assumption rules out much probability of a conflict between the requirements of ISO 14000 and the requirements of international trade law as applied by the WTO agreements. It cannot be said that ISO 14000 is inappropriate to international trade. Indeed, has been designed principally to support the smooth flow of trade.

Nevertheless, the WTO has not come across any cases till date, concerning these matters or issues and thus, this explanation is preliminary. As jurisprudence develops, various new issues may crop up. The second issue as raised by the WTO agreements and ISO 14000 relates to eco-labelling. There may be a probability that an eco-label may become a formal or informal necessity to market a product in the country. Eco-label may become a technical hurdle in trading the product and the WTO rules and regulations may prove appropriate. The re-launched Trade and Environment Committee of the WTO are observing the environmental labelling standards carefully. The association between environmental product labels and production and process methods is the point of concern for the WTO. The GATT necessitates that if the attributes of products are equal, than they may be treated as equal for the purpose of trade. Discrimination on the basis of process, methods and production used in the manufacturing of the product in accordance with the most broadly held interpretation of the rules and regulation is not permitted.

Eco-labelling requirements, since these are normally founded on life cycle assessment or evaluation methods, have a possibility of entering the area of production and process methods. Moreover, there is a likelihood of the eco-label being challenged if they are used to restrict market access. It would be so because a government necessity for eco labels as a condition for government procurement or importing would become a technical hurdle for trade and become equivalent to a government regulation. Any such regulations must be challenged under the WTO rules.

This is a question that would be pertinent for the WTO as well as the ISO labelling standards. Process changes are the medium of environmental improvement gains or benefits. How can eco-labelling standards be written without addressing production procedures and methods? A WTO secretariat paper prepared for the Committee on Trade and Environment contends that the TBT was initially intended to cover standards based on process and production methods, yet there is no consensus on this question amongst the members.

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### **Check Your Progress**

1. What do you mean by energy resource management?
2. Define biodiversity.
3. What is an environment management system?
4. State the main aim of ISO 14001.

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## 4.3 ENVIRONMENTAL CLEARANCE FOR ESTABLISHING AND OPERATING INDUSTRIES IN INDIA

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In 1994, the Ministry of Environment and Forests (MoEF) issued notification making Prior Environmental Clearance (PEC) mandatory for select categories of developmental and industrial projects. Subsequently, a number of amendments were brought out. However, the process of obtaining environmental clearance was perceived to be cumbersome and inordinate delay in granting clearances has been a major cause of concern. The MoEF, therefore, embarked upon to revise or re-engineer the environmental clearance process. The Final Notification was published on 14 September 2006. Highlights of the Notification are as follows:

### Authorities/committees

- For all States and Union Territories, State Level Environment Impact Assessment Authority (SEIAA) shall be constituted by the Central Government comprising a Chairman and a member Secretary in consultation with the State Government or the Union territory Administration concerned. The non-official member and the Chairman shall have a fixed term of three years. All decisions of the SEIAA shall be unanimous and taken in a meeting. The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC).
- At the Central Government level, the MoEF shall be Environment Impact Assessment Authority (EIAA). The MoEF shall recommend environmental clearance based on the recommendations of an Expert Appraisal Committee (EAC).
- The composition of EAC and SEACs shall be as given in Appendix VI of the Notification. The EAC and SEACs shall function on the principle of collective responsibility. The EAC and SEAC shall meet at least once every month. The EAC and SEACs shall be reconstituted every three year.

### Projects/activities requiring environmental clearance

All new projects or activities and/or expansion and modernization of the existing project or activities or any change in product-mix in an existing manufacturing unit included in the Schedule of the Notification shall require Prior Environmental Clearance (PEC) from MoEF for matters falling under Category 'A' and from SEIAA for matters falling under Category 'B' before any construction work.

- Mining, primary processing, material production, manufacturing/fabrication, industrial estates/parks/complexes/areas (EPZ SEZ), common effluent treatment plans, common biomedical treatment facilities, common municipal solid waste facilities and isolated storages and handling of hazardous chemicals, new construction projects and township projects are included in the Schedule.
- Any project or activity specified in Category 'B' in the Schedule will be treated as Category 'A', if located in whole or in part within 10 km from the

boundary of (i) Protected areas notified under the Wildlife (Protection) Act 1972, (ii) Critically polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified eco-sensitive areas, and (iv) Interstate boundaries and international boundaries.

#### **Validity/transferability of environmental clearance**

The prior environmental clearance granted shall be valid for a period of ten years in the case of river valley projects, maximum of thirty years for mining projects and five years in the case of all other projects and activities.

#### **National Biotechnology Regulatory Bill 2008**

This Bill is meant to set up the National Biotechnology Regulatory Authority of India to control and monitor the research, production, importation and use of products of modern biotechnology. The Government of India identifies that modern biotechnology offers opportunities to address significant requirements regarding health, agriculture and food production, environmental preservation, climate change and sustainable development. All these have profound impact on society and the economy. So, modern biotechnology must be developed in an accountable manner in harmony with ecological and ethical values. It is essential to safeguard the health and safety of the people of India and to protect the environment by finding potential risks posed by current biotechnology, and administration of those risks through regulating the safe growth and deployment of biotechnology products and processes. The Government of India tries to encourage the safe and responsible use of biotechnology by improving the effectiveness and competence of regulatory process and through the provision of the necessary services, infrastructure and enabling resources. The consolidation of regulatory policies, rules and services under a single biotechnology regulatory authority will facilitate a more identical and reliable approach to address the safety of biotechnology products and processes in a scientific and transparent manner.

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## **4.4 WASTE MANAGEMENT**

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Today, due to the huge volumes of solid waste released in our environment, landfills and dumping grounds have become an integral part of cities. Most of us may not be aware of the necessity of dumping grounds for keeping a delicate balance in our life and the environment. But the reality is no city can function smoothly without a centralized dumping ground or landfill. Dumping grounds are provided in cities on the basis of projected waste generation in the future. Any changes in waste projections would require immediate action for creating or rearranging the dumping sites.

Solid waste is categorized into three types depending on the source of its generation. These types are as follows:

- (a) **Household waste:** This is also called municipal waste and it consists of the waste from construction and demolition of buildings, broken glasses, paper, kitchen waste like vegetable peels, leftover fruit, etc.
- (b) **Hazardous waste:** It is also called industrial waste because the sources of its generation are mostly industries. This includes toxic substances, which

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can cause harm to the ecosystem or animals and humans who come in contact with them. It can also be flammable, making it even more dangerous to be left around. Metals like mercury and cyanide are particularly dangerous because an unprotected encounter with them can be fatal.

- (c) Biomedical or hospital waste:** Sometimes this waste is also called infectious waste because it can be the reason for the outbreak of diseases in a community. This waste has to be disposed of in a protected environment by the employees who have been trained and given equipment to keep themselves protected from its ill-effects. Bandages, swabs, culture samples and syringes are some examples of the infectious waste.

### Disposal of Solid Waste

India is estimated to produce 960 million tonnes of solid waste annually. This large amount of waste cannot be released into the environment without human or mechanical intervention. Therefore, arrangements are made to pick up solid waste from every locality, industrial unit and healthcare centre. Waste collection from different sites is coordinated to ensure that a particular waste (for example, non-biodegradable waste) from a region reaches its earmarked disposal site in an efficient manner at the earliest.

Solid waste management may be defined as an integrated process of collection, sorting, transporting, storage, treatment, recycling, reusing and disposal of solid wastes. All the steps of this integrated process are conducted simultaneously one after the other.

An important objective of solid waste disposal is to try to recycle the waste that comes in. Therefore, people are encouraged to recycle a number of products. Besides, governments and industries also take steps for waste recycling. Regarding waste recycling, a programme which has given good results is kerbside or curbside recycling, introduced by the United States Environmental Protection Agency (EPA). Curbside recycling serves half of the US population as the most convenient means for recycling a variety of household materials. It is a municipality programme that is operated to pick up a specific set of recyclable materials every week from households. A curbside recycling service commonly provides a bin or bins from which materials will be collected. Its employees come in pickup trucks with small equipment which can be used to break down waste products into recyclable parts. If the recyclable parts do not find users in a particular community, they are sent for sale in other communities. The most commonly included materials covered in curbside recycling are 'the big five': aluminium, glass, paper, plastic and steel. In many communities, curbside recycling has proven less costly than solid waste services.

In case of India, National Solid Waste Association of India (NSWAI) is a prominent professional non-profit organization for solid waste management including toxic and hazardous waste and also biomedical waste in the country.

The following sections describe some of common solid waste disposal methods or techniques.



### (a) Landfill

A landfill is a site where solid waste is dumped and eventually buried in the ground to allow its disposal through decomposition. This is the oldest technique of solid waste disposal but landfills are still used widely around the world for solid waste disposal. In some cases, landfills also act as a storehouse for the waste before it is taken for further treatment. Landfill facilities can be private where a producer of the waste, for example, an industrialist, uses the site for disposing of his industrial waste. In this case, landfill is called internal waste disposal landfill. There are also public landfills which are owned by local government bodies. In these landfills, public waste is collected and disposed of. A public landfill is also called external waste disposal landfill.

While dumping waste in a landfill, the following three things must be taken care of:

- The waste must cover minimum area.
- It must be low in volume.
- It should be covered with a layer of soil every day.

When a waste-laden truck is brought into a landfill, the truck is weighed to get an estimate of the waste amount. When the waste is dumped in the landfill, a roller runs over it to compress it and make its layer as thin as possible. Then, a layer of soil, wood chips or chemically fixed bio solids is spread over the dumped waste on it every day to allow waste decomposition. A waste layer gets further compressed when subsequent layers of waste are dumped on it.

#### Advantages

- A landfill can be used as a huge energy source because the breakdown and decomposition of solid waste produces large amounts of carbon dioxide, nitrogen, methane, etc.
- No open burning, ultimate disposal
- Little odour
- Low water/groundwater pollution
- Can handle large amounts of wastes, less cost
- Filled land can be used for other purposes

#### Disadvantages

- They may cause damage to the environment. The soil and groundwater in the vicinity of a landfill could be polluted with the dumped solid wastes.
- Some chemicals or harmful substances from the waste may also seep through the ground surface to pollute soil and water.
- Landfills are a breeding ground for rodents, insects, harmful bacteria, etc., which could lead to a number of diseases.
- Slow decomposition of waste.
- Encourages waste production.
- Noise, dust and traffic.

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### (b) Incineration

Incineration or thermal treatment of waste involves heating the waste to burn the organic matter and reduce the other solid mass to ash. The three end-products of incineration are: heat, ash and flue gas. The flue gas needs to be treated before its release into the atmosphere. The heat is generally used to produce electricity. The ash, which is produced mostly by burning of the inorganic substances in the waste, turns into solid lumps. Some ash may also escape with the flue gas. Incineration reduces the solid mass of waste by 80-85 per cent and the volume by 90-95 per cent. Incineration may not be used as widely as landfills for waste disposal, but it significantly speeds up the process of garbage breakdown as compared to landfills.

#### Advantages

- It leads to conversion of waste into energy by the way of heat generation which is used to produce electricity or in other useful ways.
- Incineration is a great remedy to prevent diseases breaking out from hazardous and infectious waste.
- Harmful pathogens and toxins present in the waste cannot survive the high incinerating temperatures and thus are killed.
- Incineration does not release methane or other greenhouse gases into the ecosystem, thus help in maintaining the ecological balance.
- Incineration is a good waste disposal option in areas where land scarcity prevents the use of landfills.

#### Disadvantages

- Highly toxic fly ash could travel long distances, causing havoc on its way.
- Emission of metals like manganese, nickel, arsenic, lead and mercury.
- Incineration plants are expensive to build and maintain. They need regular maintenance which in many cases needs a complete shutdown of the process.
- Carcinogenic compounds like PCDD and PCDF's (dioxins and furans) may be formed under specific conditions.

### (c) Pyrolysis

Pyrolysis is the process of thermally and chemically changing the properties of a waste product to make it less harmful to the environment and more suitable for disposal. In this process, solid waste is decomposed using thermal techniques and chemical changes in the absence of external oxygen. Normally, pyrolysis is carried out at around 500°C. Many types of waste like medical waste, wood, biomass, plastic, rubber and contaminated soil can be treated through this process. Also, it serves as a good means to convert waste into energy and in the process produces a number of end-products like electrical energy, black carbon, non-oxidized metals and fertilizers. Pyrolysis being an efficient process is gaining approval and acceptance in the industry.

Earlier, pyrolysis was used to be carried out in batches but this was a time-consuming and labour-intensive procedure. Now pyrolysis is conducted as a

continuous process where the waste is subjected to heat in a rotatory kiln in the absence of free oxygen. This produces syngas (synthesis gas) which is sent to boilers to produce steam that is used in electricity generation. Depending on the kind of wastes being treated, pyrolysis may be used in different ways and the end-products obtained would be used for different purposes.

#### **(d) Compositing**

Like landfills, composting is one of the oldest ways of disposing of organic waste. Compositing is a process in which bacteria and fungi are used to break down organic waste and produce an end-product called compost which has high carbon and nitrogen content along with other nutrients. Compost is used as a natural fertilizer in fields and in other planting areas like nurseries. Compost is cheap, easy and safe to use and clean. The cultivating areas where compost is used are less likely to suffer soil erosion because of the compost cover on top. Also, compost allows the soil to remain cool in summers and warm in winters to give plants a moderate temperature to survive. It is also a good means to prevent weed growth. For treating municipal waste, which has an organic content of up to 35-40 per cent, compositing is a useful method. Compositing is a good option to prevent the kitchen waste lying unattended and causing contamination and stench from its unregulated decomposition in the open.

Vermicompost, a product of vermicomposting, is also quite popular these days. In vermicomposting, worms are used to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicast is the end-product of the breakdown of organic matter by a species of earthworm.

#### **Municipal Solid Waste Management**

The municipal solid waste management is an integrated process of waste collection and waste treatment carried out by municipal authorities. In this type of waste management, waste is collected from different places and brought to one place for treatment. The collected waste is then exposed to the Integrated Solid Waste Management (ISWM). ISWM consists of a set of techniques and practices used to break down solid waste into components which are not harmful to the ecosystem and can be left in the open without any threat to life. ISWM is a six-step process which is described as follows:

- **Waste generation:** Waste is generated when certain materials are considered of no value and are sent for disposal. Normally, waste-generation is not controllable because most of human and industrial activities produce waste which needs to be disposed of. However, efforts are being made to encourage people to reuse/recycle things to make their maximum use and bring waste to the minimum.
- **Waste handling, sorting, and storage and processing at source:** This step is carried out at the source of waste generation. Waste is categorized as per its nature and type and then stored before its collection for treatment.
- **Collection:** Waste collection could be carried out through a centralized or door-to-door service given by the municipal corporation. Through this service

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waste is picked up from a number of areas, institutions, houses, etc. and brought to a single treatment unit where it can be disposed of and made into less harmful products.

- **Sorting, processing and transformation of solid waste:** Before sending the collected waste to the treatment plant for final disposal, certain portions of it, which may require preparatory treatment, are separated. During preparatory treatment, harmful substances of the waste could be changed to less harmful ones. After subjecting the separated portions to preparatory treatment, they are sent to appropriate treatment plants.
- **Transfer and transport:** In this step, semi-treated waste is picked up and taken to larger processing units to get better results through waste decomposition and breakdown.
- **Disposal:** When after treatment, waste is deemed safe then it is disposed of in the environment. Through landfills, composting or other means, the treated waste is allowed to mix with the environment.

ISWM is an on-going process that is carried out around us every day to ensure that our locality, institutes and homes remain free from solid waste. Otherwise, solid waste would simply get piled up in our neighbourhood and harm us, animals and, above all, the environment.

### Recycling of Solid Waste

Recycling of solid wastes implies analysing the sorted wastes to see if any of them could be put into a product or changed in terms of characteristics for reuse. In other words, reuse or recycling means modifying or breaking down a product to get a new product. Solid waste after collection is analysed to see the kind of things it contains. Things like paper, plastics, glass, ceramics, cans and utensils can be easily reused to produce new products. Even e-waste is now being reused the same way. Items like glass, metal or plastic are melted and reshaped to form other things which can be used as containers, storage items, etc. For example, paper and cardboard can be recycled into bags, boxes, cartons, etc. E-waste is broken down and the functional electronic components are picked up for reuse as spare parts in other electronic products.

Recycling of solid waste reduces its disposal rate. It ensures that items, which are termed as waste but still have certain utility, are picked and sent for modification instead of throwing them. Currently, India is estimated to recycle approximately 15 per cent of the collected waste while the rest is sent for treatment. With further development and innovation, more recycling will lead to more reuse of solid waste.

### Industrial Solid Waste Management

Industries are a major source of solid waste generation. Thus it is important for industries to practice waste management techniques for reducing the waste they send out for disposal. Some industries partially treat their waste before it is sent for further treatment. However, simply recycling and treating the waste does not mean industrial solid waste management. The industrial solid waste management is the process of devising and implementing techniques for reducing raw material

wastage, improving the quality of products and reducing the toxicity of waste. Actually, the industrial solid waste management begins with the production process in an industry. The steps to be followed in the industrial solid waste management are as follows:

- **Inventory management and improved operations:** Industries should make sure that they do not create bulk inventory of raw materials or over-produce goods which can lead to huge surpluses and wastages. They need to be certain about the amount of raw materials required for their production operations. Besides, they should also keep devising new ways of reducing the overall use of raw materials to reduce wastage and improve cost efficiency. They should also use organic and non-toxic raw materials as far as possible.
- **Modified equipment:** Industries can go for advanced equipment which helps reduce product wastage by economical use of raw materials. Also, changes in the product line design and production time could help reduce product wastage.
- **Production process change:** Any kind of damages like spills and leaks in the production line should be taken care of urgently to ensure minimum wastage of materials. Also, industries should assess their production process for using new techniques which can reduce production of hazardous materials in the production line.
- **Recycling and reuse:** The final waste of the production process should be analysed for any material which can be put back into the production line for further use. Waste may also contain some products which can be sent for modification and then recycled. Only those products which have no utility at all should be sent for waste disposal.

The comprehensive industrial solid waste management, if practiced properly, can help reduce industrial solid waste at all levels of production. This would allow the industry to be more cost-effective as well as environment-friendly.

### **Biomedical Waste Management**

The biomedical waste management is the systematic collection, sorting and disposal of hospital waste. Hospital waste could be infectious or injurious to humans, and chemical drugs could be toxic. Thus extra precautions need to be taken for handling this waste. Biomedical waste is divided into ten categories and put into colour coded bags for storage, transportation and treatment.

### **Ecological Sanitation**

Ecological sanitation views human waste as a useful resource whose nutrients could be sent back to the soil. It brings together human waste, rain water, grey water and wastewater for treatment. Ecological sanitation is the process of collecting human waste and separating urine from the faecal matter and then treating both separately to get such products that could be beneficial to the environment or whose disposal would not damage the harm the environment. For treatment, human waste is mixed along with grey water and rain water. This mixture is then put through different treatment processes and used in the most efficient way possible.

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Figure 6.1 depicts the ecological sanitation process. The solid matter of human waste can also be converted into biofuel for use in a number of applications.

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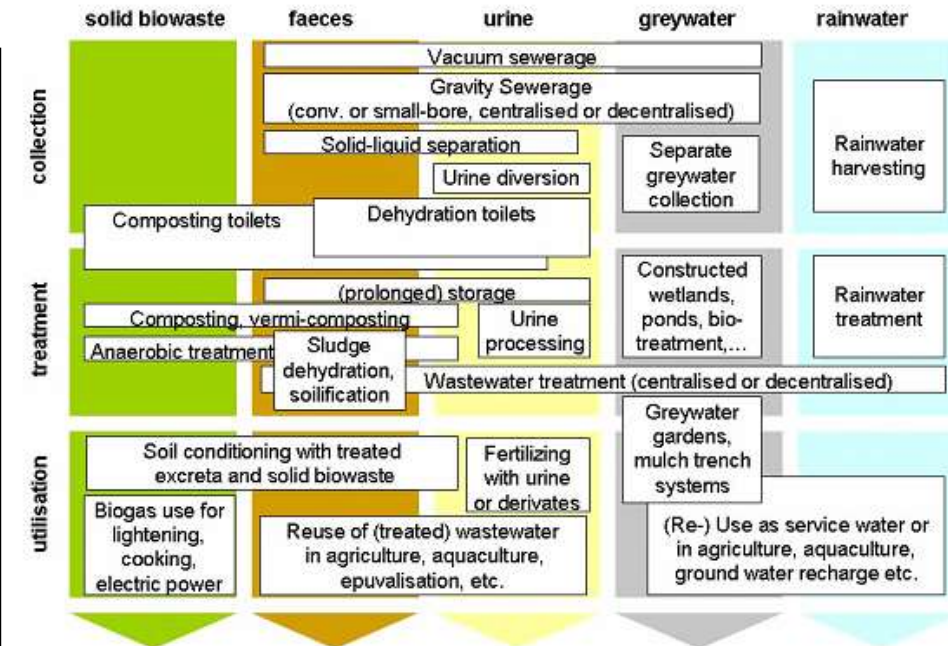


Fig. 4.2 The Ecological Sanitation Process

Source: <http://upload.wikimedia.org/wikipedia/en/5/51/Gtz-technologies-for-ecosan.jpg>

Table 4.1 Categories of Biomedical Waste and Techniques for their Treatment

Categories	Waste Products	Colour of Bag	Treatment
1	Human anatomical waste	Yellow	Incineration/Burial
2	Animal waste	Yellow	Incineration/Burial
3	Microbiology and biotechnology waste	Yellow/Red	Autoclave/Microwave
4	Waste sharps	Blue/White	Autoclave/Microwave
5	Discarded medicines and cytotoxic drugs	Black	Secured landfills
6	Solid waste: plasters, bedding, dressing	Yellow/Red	Autoclave/Microwave
7	Solid waste: tubes & catheters	Red/Blue/White	Autoclave/Microwave
8	Liquid waste and washing residue	Drainage	Wastewater treatment
9	Incineration ash	Black	Secured landfills
10	Chemical waste	Black	Secured landfills

Table 4.1 lists different categories of biomedical waste with their respective coloured storage bags and treatment techniques.

**Grey Water Management**

The grey water management is the process of managing wastewater from households apart from the one mixed with human waste. In other words, the grey water management is the process of reduction, treatment, disposal and reuse of grey water which has been collected in a community. Grey water is not very high in nutrients or toxins. It contains a certain amount of dirt and impurities. Its pH level is basic because of the dominance of soap water in it. Grey water has small amounts

of organic wastes which can be easily decomposed by micro-organisms. It is due to the organic waste that the stagnant grey water or the one that has been stored for too long develops a pungent smell. For grey water management, a large, common pipe is attached to every household to direct its grey water output to the locality's main storage. All this collection is taken for treatment. The treatment is mostly conducted using soil filters or bio-rotors. In both cases, grey water is allowed to pass through a substrate which is the habitat to a number of micro-organisms. They attach themselves to the organic waste and decompose the same. This treatment is sometimes used in combination with processes like sedimentation and skimming to get the water which can be reused in agriculture and for irrigation in cities and ground water restoration.

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### 4.4.1 Hazardous Waste Management

Hazardous waste is commonly produced in industries and hospitals. Hazardous waste of industries contains chemicals and toxic substances that can be very harmful to the humans and surroundings which are exposed to them. Hazardous waste of hospitals contains pathogens, chemicals and substances which could be harmful to humans and the environment if not disposed of properly. Pathogens in the waste pose the grave risk of spreading diseases and illnesses.

The equipment and storage space, used to handle both the industrial and hospital waste, can also carry toxins. Even small traces of waste, left on the equipment or in storages, can cause dangerous side-effects to a large number of people. Hazardous waste has been carefully classified into eighteen categories. Identification of the source and category of hazardous waste helps trace the cause of its generation and how it can be reduced at the source itself. It also helps in deciding an appropriate method or treatment for its disposal.

#### Category and source identification

*Table 4.2 Hazardous Waste Classification*

Waste Category	Type of Waste
Category No. 1	Cyanide waste
Category No. 2	Metal finishing waste
Category No. 3	Waste containing water soluble chemical compounds of zinc, copper, lead, chromium and antimony
Category No. 4	Mercury, arsenic, thallium, cadmium bearing waste
Category No. 5	Non-halogenated hydrocarbons including solvent
Category No. 6	Hydrogenated hydrocarbons including solvent
Category No. 7	Wastes from paints, pigments, glue, varnish and printing ink
Category No. 8	Wastes from dye and dye intermediate containing inorganic chemical compound
Category No. 9	Wastes from dyes and dye intermediates containing organic chemical compounds
Category No. 10	Waste oil and oil emulsions
Category No. 11	Tarry wastes from refining and tar residues from distillation or prolytic treatment

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Category No. 12	Sludges arising from treatment of waste waters containing heavy metals, toxic organics, oil emulsions and spend chemical and incineration ash
Category No. 13	Phenols
Category No. 14	Asbestos
Category No. 15	Wastes from manufacturing of pesticides and herbicides and residues from pesticides and herbicide formulation units
Category No. 16	Acid/Alkaline/Slurry
Category No. 17	Off-specification and discarded products
Category No. 18	Discarded containers and container liners of hazardous waste

*Source:* [envis.kuenvbiotech.org/Hazardous-waste-managements.doc](http://envis.kuenvbiotech.org/Hazardous-waste-managements.doc)

As we can see in Table 4.2, there are eighteen categories into which hazardous waste has been classified. This categorization helps in deciding the nature of the waste and how it should be treated.

Knowing about the components that are hazardous in a waste is only one aspect of hazardous waste management. Identification of hazardous waste source is also very crucial to its proper management. Understanding how the hazardous waste has been produced allows one to estimate the damage it can cause and choose the best mode for its treatment. Also, tracing back the source of hazardous waste helps organize the required collection and transportation facilities.

### Characterization

Hazardous waste has four main characteristics which are responsible for causing ill-effects to the humans or surroundings. Any waste which has one or more of these characteristics is categorized as hazardous waste. These characteristics are as follows:

- **Flammability:** This decides how easily hazardous waste can catch fire and how difficult it could be to put the fire out. Waste flammability helps estimate the kind of damage the waste can cause and know about the substances which can be used to treat it. This also gives the idea to keep it well stored and devise safety techniques to overcome any potential danger.
- **Reactivity:** This means the waste might chemically react with skin, air or even water to cause devastating results. Or, it could even mean that the waste can trigger nuclear reactions that release high amounts of energy which cannot be curbed without proper equipment.
- **Corrosiveness:** This indicates the waste's ability to damage or destroy anything it comes in contact with. The damage done is almost always irreversible.
- **Toxicity:** This is the degree to which the waste can cause damage to non-living and living things. Toxicity of a substance decides the way cells, tissues, organs or other substances would deteriorate. It has the ability to rearrange the substructure of organisms.

### Quantification

Quantification of hazardous waste is the estimation of waste production in an area. It helps researchers assess the amount of waste generation from a particular



product or process. Accordingly, benchmarks are set to bring down the waste quantity and new methods are devised to reduce waste generation. Quantification also helps assess the efficiency of the hazardous waste management techniques being used.

### **Hazardous Waste Handling and Disposal**

A number of precautions need to be considered while handling and disposing of hazardous waste. One must ensure that the people authorized to handle the waste are fully qualified for the job and are well-versed with all the required safety procedures. The waste-handlers must also know about the waste source and inform transporters in the vicinity about the same to ensure that the hazardous waste does not reach those dumping sites where it cannot be managed. They should also regularly check the containers used for waste storage. The containers should be guarded against the corrosive or highly reactive wastes which can damage the containers and escape into the environment. Hazardous wastes also need to be segregated during storage to ensure minimum chances of reaction with the containers or other things and also for determining the appropriate waste treatment methods.

### **Transport**

Hazardous waste needs to be transported from its production site to the site where it is treated and disposed of. Some production sites can partially treat the waste before its transportation to reduce the risks associated with its exposure. However, it cannot be treated completely unless the site of its generation is equipped with appropriate treatment technology. Small waste treatment includes changing the pH level to reduce its acidity or performing small-scale chemical reactions to prevent occurrence of dangerous reactions later on. The biggest risk during waste transportation is any kind of waste spill or leak on the way which could endanger a number of lives. Therefore, to reduce transportation risks or avoid long-distance transportation, industries are mostly located at one particular site and the waste disposal sites are also situated nearby.

Another thing that needs to be considered when transporting hazardous waste is that it should not be mixed with non-hazardous waste. Even if the two do not have reactionary properties, non-hazardous waste can become infectious or acquire harmful traits. But the waste-handlers may not know of this change in the properties of non-hazardous waste and would unsuspectingly subject themselves to grave risks.

### **Storage**

Hazardous waste storage is a time-bound process. After its generation, the waste is stored at the source site for certain duration before its transportation to a disposal site. Even after transportation, the waste may be stored at the disposal site itself for some time before its treatment and final disposal. Waste storage must be carried out with required precautions. The storage containers must be resistant to any reaction with hazardous waste because reaction with the waste may cause waste leakage, leading to devastating results for the humans and surroundings. Besides, the waste containers after reacting with the waste may suffer permanent damage and become useless.

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People involved in handling the storage of the hazardous waste need to take extra precautions to ensure that they do not come in direct contact with the same. During both storage and transportation, the containers should be appropriately coloured or labelled with a statutory warning. The labels on the containers are of vital importance. These labels must correctly identify the waste in the containers and list its various properties such as corrosiveness, toxicity, reactive and infectious nature. These labels enable the waste-handlers do their work without exposing themselves to unwanted risks.

### **Disposal of Small and Large Quantities**

Disposal of both small and large quantities of waste is done on the basis of the hazardous waste mapping system. This system allows one to carry out the required procedures for all types of wastes to ensure proper treatment and disposal. Monthly output of hazardous waste amounting to 100 kilograms or more but less than 1,000 kilograms is termed as small-quantity waste. This waste can be stored on the site of its generation for up to 180 days before transportation for disposal. The waste storage on the site must not exceed 6,000 kilograms, and well-trained, educated employees should be deployed for efficient handling the waste storage. They should ensure that the waste does not produce the harmful effects on its surroundings. They are also responsible for any emergencies arising out of waste storage.

Monthly output of hazardous waste exceeding 1,000 kilograms is termed as large-quantity waste. These wastes cannot be stored on site longer than 90 days and must be sent for disposal within this time. The industry staff needs to regularly track the production, storage and transportation of waste in large quantities, and also be ready to carefully tackle any emergencies. The industries producing large quantities of waste need to submit the biennial hazardous waste report to the government.

### **Disposal of Dioxin, PCB and Toxins**

Wastes containing dioxins, PCB and toxins, on coming in contact with other kinds of waste at the disposal site, can lead to harmful chemical reactions, corrosive damages, etc. Therefore, these wastes must be disposed of in strict accordance with the government-approved methods. These wastes can be disposed of in landfills, or can be treated with chemicals. These can also be subjected to incineration. However, all these methods need government approval before implementation. Without this approval, a site cannot be used for dioxin, PCB and toxins disposal. And, a site once designated for this purpose cannot be shared with other kinds of waste. Other techniques, used for disposing of dioxin/toxin-containing waste, include physical/chemical extraction techniques, biological reduction methods, melting furnace, pyrolysis, etc.

Hazardous waste disposal sites need government approval because hazardous waste cannot be disposed along with other wastes in general sites. Neither can it be disposed of in areas near to human habitations. Thus government employees must approve hazardous waste disposal sites before they become operative.

## Disposal of Infectious Hazardous Waste

The best method for disposing infectious hazardous waste is incineration or any other thermal technique. Incineration is preferred the most because it effectively reduces the mass and volume of the waste. Another notable advantage is that this high-temperature process also kills any pathogens that can spread diseases and infections. However this method cannot be used all the time. There are also other methods for disposal of infectious hazardous waste but they are not always the best alternative. One such method is sterilization by autoclaves, which is also called autoclaving.

An autoclave is a device which rids hospital equipment of traces of hazardous waste by subjecting them to high pressure saturated steam. Liquid and semi-solid infectious waste can be disposed of in sewers which have been approved for such disposal. The sewer endings are directly linked to the disposal sites where the waste is collected for treatment. An essential precaution for handling infectious hazardous waste is that its disposal must be carried out within a week. Otherwise, the storage containers may become a breeding ground for pathogens which can pose grave risks to the people around.

## Hazardous Waste Management in India

The Ministry of Environment and Forests (MoEF), Government of India issued a notification on 28 July 1989, which informed that the Hazardous Waste (Management & Handling) Rules (HWM Rules) will deal with wastes which are not covered under the Water and Air Acts. These wastes include hazardous waste (HW), mostly solids, semi-solid and other industrial wastes. The notification, designed under the provisions of the Environment (Protection) Act, 1986, was introduced to facilitate the management of waste handling, treatment, transport and disposal in an environmentally sound way by the authorities.

In 2000 and 2003, the notification was further amended. These amendments were presented as Schedule I and Schedule II. Schedule I identified hazardous wastes by means of waste streams and industrial processes, while Schedule II identified the concentrations of specified components of the hazardous waste. Further, Schedule VIII was formulated, which identified the categories of wastes that were prevented from being exported or imported. The procedure for the registration of the reprocessors/recyclers possessing environmentally feasible facilities for processing waste categories like non-ferrous metal, used lead acid batteries and used oil as contained in Schedule 4 and Schedule 5 respectively has also been laid down.

Hazardous waste management in India has been divided into the following seven steps to ensure adherence to all essential precautions and prerequisites of the process without any hindrance. These steps lay down the basic procedure that needs to be followed for safe disposal of hazardous waste.

- **Identification of hazardous waste:** The first step is to identify hazardous waste, that is, whether a particular waste is hazardous or not. Identifying a waste as hazardous and locating its generation site bring it under close scrutiny of government authorities. Then they coordinate

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collection and transportation of the waste to the disposal sites nearest to its generation area to reduce any risks and accidents which could occur if it is sent for faraway disposal.

- **Data collection:** Questionnaires, field visits and surveys help estimate the hazardous waste being produced at different sites in an industrial area. Depending on the estimated amount of waste and the availability of storage facilities, the decision is taken to prioritize waste collection from the sites.
- **Waste categorization:** The waste needs to be correctly categorized into its respective category to decide suitable treatment for it. If the waste categorization is wrong, it will not get disposed in the right manner and then it can be harmful to the environment as well as the people in the area.
- **Quantification of hazardous waste:** Different kinds of hazardous waste being generated in an industry or a region are quantified to estimate the scale of the required waste treatment and have an idea of the potential risks. Quantification helps in estimating the wastes being produced in every process and how each process can be improvised to reduce waste production.
- **Identification of disposal sites:** Government officials visit prospective sites which can be used for waste disposal. The chosen site should be far away from the high-density population areas and it should have enough space to accommodate waste disposal equipment. It should also be equipped with good transport facility to allow easy waste collection at the site.
- **Conducting EIA:** The environmental impact analysis (EIA) helps one understand how the hazardous waste is going to be harmful to the environment. It helps in deciding why it is important go for systematic hazardous waste disposal. It also gives an idea of the adverse effects on the waste-handlers and how those can be prevented.
- **Implementing TSDF programme:** The TSDF (Transport Storage and/or Disposal Facility) Programme decides how the hazardous waste would be treated. It lists techniques which would be used for certain categories of hazardous waste and why these techniques would be appropriate for these wastes. This programme also decides on the labels, messages and pictures which need to be used to classify hazardous waste for all those dealing with it.

### **Present hazardous waste generation scenario**

India generates about 4.4 million tonnes of hazardous waste on an annual basis. As per the estimates by the Organization for Economic Cooperation and Development (OECD), around five million tonnes of hazardous waste are being produced in India on an annual basis. These estimates are based on the eighteen categories of wastes that appeared in the HWM Rules published in 1989. Out of this, 38.3 per cent is recyclable, 4.3 per cent is incinerable and the remaining 57.4

per cent is disposable in secured landfills. Twelve States of the country (Gujarat, Maharashtra, Orissa, Tamil Nadu, Assam, Madhya Pradesh, Kerala, Uttar Pradesh, West Bengal, Andhra Pradesh, Karnataka and Rajasthan) account for 97 per cent of the total hazardous waste generation.

Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu are the top four waste generating states. Oppositely, the states like Jammu & Kashmir, Himachal Pradesh, all the North Eastern States excepting Assam produce less than 20,000 MT annually. The approach to waste management should be necessarily state-specific because of the wide variations in quantity and nature of waste produced among the states and union territories (UTs). It is also required because of the big variations in climatic as well as hydro-geological conditions in various regions of India.

As a result of the amendments made in 2000 and subsequently in 2003, the State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) have undertaken the process of re-inventorizing hazardous waste generated. These steps have brought to light the serious short-comings in the earlier inventorization.

**Table 4.3** State-Wise Status of Number of Units generating Waste and quantities of Waste

State-wise status of number of units generating hazardous waste, and quantities generated in wastes types (recyclable, incinerable and disposable).

S. N.	State	No. of Districts		No. of Units Generating Wastes		Quantity of Waste Generated (Waste Type) [ in TPA ]			
		Total	H.W. Units	Autho- rised	Total	Recycl- able	Inciner- able	Disposal	Total
1	Anhra Pradesh	23	22	478	501	61820	5425	43853	111098
2	Assam	23	8	18	18	-	-	166008	166008
3	Bihar	55	12	31	42	2151	75	24351	26578
4	Chandigarh	1	1	37	47	-	-	305	305
5	Delhi	9	9	-	403	-	-	-	1000
6	Goa	2	2	25	25	873	2000	5869	8742
7	Gujarat	24	24	2984	2984	235840	34790	159400	430030
8	Haryana	17	15	42	309	-	-	31046	32559
9	Himachal Pradesh	12	6	71	116	-	63	2096	2159
10	Karnataka	27	25	413	454	47330	3328	52585	103243
11	Kerala	14	11	65	133	93912	272	60538	154722
12	Maharashtra	33	33	3953	3953	847436	5012	1155398	2007846
13	Madhya Pradesh	61	38	183	183	89593	1309	107767	198669
14	Orissa	30	17	78	163	2841	-	338303	341144
15	J & K	14	5	-	57	-	-	-	1221
16	Pondicherry	1	1	15	15	8730	120	43	8893
17	Punjab	17	15	619	700	9348	1128	12233	22745
18	Rajasthan	32	27	90	344	52578	6747	95000	140610
19	Tamil Nadu	29	29	1088	1100	193507	11564	196002	401073
20	Uttar Pradesh	83	65	768	1036	36819	61395	47572	145786
21	West Bengal	17	9	234	440	45233	50894	33699	129826
	TOTAL	524	373	11138	13011				4434257

**Source:** <http://www.envis.neeri.res.in/management.php>

Table 4.3 depicts the status of number of units generating hazardous waste and the quantities generated in waste types, such as recyclable, incinerable and disposable.

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### The Basel convention on hazardous wastes

India is a signatory to the Basel Convention on transboundary movement of hazardous wastes. The Basel Convention aims to control and reduce the transboundary movements of hazardous and other wastes. The Convention has the objectives of prevention and minimization of hazardous waste generation, environmentally appropriate management of these wastes, and the promotion and use of cleaner technologies.

As a member of the Convention, India is under obligation to regulate and minimize the import of hazardous waste or other wastes for disposal or re-cycling. The country is also obliged to prohibit the export of waste to the parties that have prohibited the import of these wastes. As a member, India is also needed to minimize the generation of hazardous waste in its territory taking into account the social, technological and economic aspects. Moreover, hazardous waste produced in the country has to be managed in an environment-friendly manner. As a party, India can prevent the import of hazardous waste or other waste if it believes that the concerned waste cannot be managed in an environmentally feasible way.

#### Check Your Progress

5. How does the Government of India promote use of biotechnology?
6. What is a landfill?
7. What is grey water management?
8. What are the main characteristics of hazardous waste?
9. How is infectious hazardous waste disposed?

## 4.5 BUSINESS, INDUSTRY AND ENVIRONMENT

Maximize profits was the underlying maxim in the hey-day of *laissez-faire* capitalism of Europe. Social responsibility had no place in its philosophy. *The business of business is business*. Business began merely as an institution for the purpose of making money. So long as a man made money and kept himself out of jail he was considered successful. He felt no particular obligation and acknowledged no responsibility to the community. As he was the owner of his business he thought he had a perfect right to do with it what he pleased. 'The public be damned'. Social welfare was not his job.

But such attitude does not hold good in the present situation. The recognition of social responsibility has been termed as the emergence of corporate conscience.

Business is not an end in itself. It is only a means to an end. That end is man himself. Therefore, business has to contribute to man's happiness, his freedom, his material, moral and spiritual growth.

### Nature of Social Responsibility

Social responsibility of business involves consideration of general public interest by businessmen while taking business decisions and actions.

According to Bowen, social responsibility refers to the ‘obligations of businessmen to pursue those policies, to make those decisions or to follow those lines of action which are desirable in terms of the objectives and values of our society.’

This entails that businessmen should perform their operations with due consideration of the aspirations of society. They should fulfil the demands of those who have a claim in the operations of business. They must measure the consequences of their decisions and courses of action on the society and ascertain that no undue harm is done to the interests of the society.

### **Need for Social Responsibility of Business**

1. *The Iron law of responsibility:* The institution of business exists only because it performs an invaluable service to society. Society gives business its charter to exist and the charter can be amended or revoked at any time if it fails to live up to society’s expectations. Therefore, if business intends to retain its existing social role and social power, it must respond to society’s needs constructively. This is called the ‘iron law of responsibility’, which is that in the long run, those who do not use power in a manner which society considers responsible will tend to lose it. Though the long run may be decades or even centuries in some instances, history confirms that society ultimately acts to reduce the power of those who have not used it responsibly.
2. *To fulfill long-term self-interest:* A business organization most sensitive to community needs would in its own self-interest like to have a better community in which to conduct its business. To achieve that, it would implement special programmes for social welfare. As a result of social improvements, crime will decrease. Less money will be required to protect property. Labour recruitment will be easier. Turnover and absenteeism will be substantially reduced. A better society would produce a better environment in which the business may aim at long run profit maximization.
3. *To establish a better public image:* Each business organization must enhance its public image to secure more customers, better employees and higher profits. The public image concept may be extended to the accomplishment of various types of social goals. According to this line of argument, social goals are now a top priority with members of the public. So, if a firm wants to project a favourable public image, it will have to show that it supports these social goals.
4. *To avoid government regulation or control:* Regulation and control are costly to business, both in terms of energy and money and restricts its flexibility of decision-making. Failure of businessmen to assume social responsibilities voluntarily invites government intervention and regulation or control of their activities. By their own socially responsible behaviour they can prevent government intervention. Businessmen have learnt that once a government control is established it is seldom removed even though the warranting conditions change. If these are the facts, then the prudent course for business is to understand the limit of its power and to use that power responsibly, giving government no opportunity to intervene.

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5. *To avoid misuse of national resources and economic power:* Businessmen command considerable power on the productive resources of a community. They are obliged to use those resources for the common good of society. They should not forget that the power to command national resources has been delegated to them by the society to generate more wealth for its betterment. They must honour social obligations while exercising the delegated economic power. Society will not indefinitely tolerate their misdeeds in wasting away these resources.
6. *To avoid class-conflicts:* Industrial peace is a precondition for the success of business. Trade unions are becoming more and more militant and demand social welfare measures, better wages, better working conditions, etc. Their demand derives its force from the fast changing social environment. Businessmen must win over the confidence of workers and avoid violent class conflicts in their own interest.
7. *To convert resistances into resources:* If the innovative ability of a business is used to solve to social problems, many resistances (problems) can be transformed into resources and the functional capacity of resources may be increased manifold. All problems may not be capable of being handled this way, but many of them would be solved to the ultimate benefit of society. It is recognised that prevention is better than cure. Any delay in dealing with social problems now may leave business managements constantly occupied with extinguishing social fires in future. It is economical and wise to deal with such problems before they snowball and become uncontrollable. Business organizations can do a lot in this regard.
8. The effluence of many factories damages the surrounding environment. They are duty-bound to repair the damage by recognizing their responsibility towards society.

### **Social Responsibility of Business towards Different Groups**

According to Earnest Dale, it is the duty of business to provide a fair return to the shareholders, fair working conditions to the employees, fair deal to the suppliers and customers and to make the business an asset to the local community and the nation.

1. *Owners of business:* Management must provide fair, adequate and stable long-run rate of return and steady capital appreciation to the shareholders for their investments. It must also provide to them regular, accurate and up-to-date information about the working of the company. Maximum disclosure about the progress and achievements of the company is very satisfying to the shareholders. It must ensure planned growth, solvency of the business and optimum utilization of the resources of the business.
2. *Employees:* Employees need security of jobs, higher wages, full employment, better conditions of work, opportunities for self-development and promotion. They want to unite and form their trade unions to achieve rights and to seek protection against high-handedness of the management. They also desire their work itself to be rewarding. Management, as a part



of its social responsibilities, is expected to provide for their social security, welfare, grievance settlement machinery and sharing of excess profits.

Management should serve as a model employer. A model employer is one who does not exploit his employees. As a model employer, the management should provide stable employment, adequate wages, good and safe working conditions, job satisfaction and opportunities for self-development. Healthy trade union practices may be encouraged. Employees may be considered as partners in business, since their interests in business is not very much different from the interests of the shareholders. They may be allowed to participate in the decision-making process at all levels of management. A feeling of fellowship and a sense of belonging to the company as a whole should be allowed to grow.

3. *Consumers:* In the words of Henry Ford, management must provide those goods and services which the society needs at a price which the society can afford to pay. Management is supposed to provide good quality products to the consumers at reasonable prices. It should develop a liberal and fair attitude towards the consumers. It must maintain regular supply of high quality products and provide services to the consumers. Managers must meet the needs of the consumers of different classes, tastes and with different purchasing powers at the right time, place, price and in right quality. A businessman should act as a friend and guide to the consumer. It is his duty to protect consumers' interest at any cost. He must guard against adulteration, poor quality, lack of service to the consumer, misleading and dishonest advertisements, under-weighting, supply of state goods, etc. He must handle the complaints of the consumers carefully and efficiently.

The concept of social responsibility of private business may be new to the western world, but in India it is not so. Gandhiji reminded us of these values when he propounded the theory of trusteeship. The rich businessman should recognize that he is the trustee for all the wealth which he has collected from the members of the society. So the entrepreneur has to strike a balance between profit and social good.

The concept of social responsibility of business was first mooted by President Wilson in USA as early as 1913 as a measure of the 'New Democracy'. He gave a new shape to the manners and morals of business through the Chamber of Commerce under the doctrine of self-rule in industry which listed fair trade practices and enforced self-discipline by the business community.

Social issues with which business corporations have been concerned since the 60s may be divided into three categories: The first of these refers to social problems external to the corporation which were not caused by any direct business action. Poverty, drug abuses, decay of the cities are examples of problems in this category. The second category consists of the external impact of regular economic activities. Pollution by production is a case in point. The quality, safety, reliability of goods and services, deception from marketing practices, the social impact of plant closings and plant location belong to this category. The final category of issues occurs within the firm and is tied up with regular economic activities. Equal

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employment opportunity, occupational health and safety, the quality of work life and industrial democracy belong to this category.

The second and third categories are of increasing importance and are tied up with the regular economic operations of business. Improved social performance demands changes in these operations.

### Barriers to Social Responsibility

There are certain limitations of social responsibility. The major limitation is that ethical behaviors or charities under social responsibility usually necessitate financial contributions. This creates a limitation, for instance, a survey was once conducted regarding the limits of social responsibility. They found some managers opining that instead of wasting time on social contributions, it was more feasible to market their products and services. Likewise, financial positions of the companies also limit them to take any action for social contribution. Limited company funds also make their contribution low in social responsibility programs. Moreover, some businesses are considered to exist purely for the entertainment of people and they are legal but they are considered unethical; e.g., alcohol business. This also puts a limitation on social responsibility. In other words, there are several policies and regulations in business which limit social responsibility.

### Check Your Progress

10. What does social responsibility refer to?
11. What is the iron law of responsibility?

## 4.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Energy resource management can be defined as the process of monitoring, controlling and conserving energy in any setting.
2. Biodiversity refers to variation of life forms within a given species, ecosystem, biome, or an entire planet. It can be defined as the variety and diversity that exist among living organisms of all species, genera and ecosystems.
3. An environment management system (EMS) is a systematic approach for incorporating environmental goals and priorities into routine operations and managing environmental programs in a planned manner. It is a set of processes and practices that enable an organization to reduce its environmental impacts and helps in achieving environmental goals through consistent control of its operations.
4. The main aim of ISO 14001 is to encourage and ascertain continual enhancement of environmental performance, prevention of pollution and compliance with legal and other requirements.
5. The Government of India tries to encourage the safe and responsible use of biotechnology by improving the effectiveness and competence of regulatory process and through the provision of the necessary services, infrastructure and enabling resources.

6. A landfill is a large area where solid waste is dumped and allowed to be decomposed by micro-organisms. The dumped waste is compacted in size and volume and covered in soil to facilitate its decomposition.
7. The grey water management is the process of managing wastewater from households apart from the one mixed with human waste. It is treated to get cleaner by-products which can be put to further use.
8. Hazardous waste has four main characteristics which are responsible for causing ill-effects to the humans or surroundings. Any waste which has one or more of these characteristics is categorized as hazardous waste. These characteristics are: flammability, reactivity, corrosiveness and toxicity.
9. Infectious hazardous wastes are disposed of using techniques like incineration or autoclaving.
10. According to Bowen, social responsibility refers to the ‘obligations of businessmen to pursue those policies, to make those decisions or to follow those lines of action which are desirable in terms of the objectives and values of our society.’
11. The institution of business exists only because it performs an invaluable service to society. Society gives business its charter to exist and the charter can be amended or revoked at any time if it fails to live up to society’s expectations. Therefore, if business intends to retain its existing social role and social power, it must respond to society’s needs constructively. This is called the ‘iron law of responsibility’, which is that in the long run, those who do not use power in a manner which society considers responsible will tend to lose it.

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### 4.7 SUMMARY

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- Environmental management offers research and opinions on use and conservation of natural resources, protection of habitats and control of hazards, spanning the field of applied ecology without regard to traditional disciplinary boundaries.
- Environmental strategies can be said to occupy four levels of sustainability: compliant, market driven, engaged, and shaping the future.
- Organizations use various approaches and tools to integrate environmental considerations into their everyday decision processes. Environmental approaches and tools can be described as operating at a management system level, a program level, or a tool level.
- Community-based water resource management has been in limelight for quite some time now. Several examples can be quoted nationally and internationally where community members have joined hands to manage this precious resource for its sustainable use. However, the present problem is not the lack of availability of water. The issues are more of lack of optimal management, better distribution mechanism and reduction of leakage. These issues have to be treated with utmost urgency.

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- Forest resource management involves the sustainable management of forests by using comprehensive social, economic and environmental goals. Forests are important ecosystem resources, and several attempts have been made to protect them to provide a sustainable resource for the future generations. The Chipko Movement is one of the most famous and commendable efforts in the area of protecting forests.
- The National Forest policy of 1988 brought about significant changes in the existing forest management policies and practices. One of the main recommendations was the involvement of people in forest conservation and management as the major means of putting off the impending ecological crises and providing the benefits of these efforts directly to the people. It was realized that conservation and proper management of forests was not possible without active participation of the local people.
- Energy resource management can be defined as the process of monitoring, controlling and conserving energy in any setting. The concept of energy resource management is still in its nascent stage in India as against the ever-increasing energy requirements of the rapidly growing economy.
- Biodiversity refers to variation of life forms within a given species, ecosystem, biome, or an entire planet. It can be defined as the variety and diversity that exist among living organisms of all species, genera and ecosystems.
- An environment management system (EMS) is a systematic approach for incorporating environmental goals and priorities into routine operations and managing environmental programs in a planned manner. It is a set of processes and practices that enable an organization to reduce its environmental impacts and helps in achieving environmental goals through consistent control of its operations.
- An environmental management system (EMS) is an autonomous system that classifies, controls and monitors facility functions that may affect the environment. It motivates facilities to address environmental problems as a regular routine of business.
- When an environmental management system is in place, it provides an organization or company with a methodical means to control their environmental affect.
- Another key benefit of implementing the ISO 14001 environment system is that it enables the hierarchy of an organization to achieve a high level of environmental performance. This additionally facilitates total dedication of an organization in controlling the effects of litter, contamination and energy utilization.
- The main advantages of adopting ISO 14001 are:
  - o Cost cutting because of higher environmental competency
  - o Reduction of environmental commitments
  - o Reduction in environmental hazards
  - o Enhancement in the organization's capability to be competitive in the international marketplace

- The ISO 14000 family contains more than 20 standards, guides and other publications, dealing with a variety of topics such as forest management and life-cycle assessment.
- The International Chamber of Commerce (ICC) proposed 16 principles. They aim to help organizations all over the world in enhancing their performance for sustainable development.
- The ISO constituent bodies in a large number of developing countries initially identified the prospective importance of the ISO 14000 series and have been functional members in the procedure developing standards.
- The Eco-Management and Audit Scheme (EMAS) is the EU's autonomous scheme made for firms and other business establishments that are committed to assess, administer and develop their environmental works.
- In 1994, the Ministry of Environment and Forests (MoEF) issued notification making Prior Environmental Clearance (PEC) mandatory for select categories of developmental and industrial projects. The MoEF, therefore, embarked upon to revise or re-engineer the environmental clearance process.
- All new projects or activities and/or expansion and modernization of the existing project or activities or any change in product-mix in an existing manufacturing unit included in the Schedule of the Notification shall require Prior Environmental Clearance (PEC) from MoEF for matters falling under Category 'A' and from SEIAA for matters falling under Category 'B' before any construction work.
- The prior environmental clearance granted shall be valid for a period of ten years in the case of river valley projects, maximum of thirty years for mining projects and five years in the case of all other projects and activities.
- National Biotechnology Regulatory Bill 2008 is meant to set up the National Biotechnology Regulatory Authority of India to control and monitor the research, production, importation and use of products of modern biotechnology.
- Solid waste management is the integrated process of collection, sorting, transporting, storage, treatment, recycling, reusing and disposal of solid wastes. All the steps of this integrated process are conducted simultaneously one after the other.
- A landfill is a large area where solid waste is dumped and allowed to be decomposed by micro-organisms. The dumped waste is compacted in size and volume and covered in soil to facilitate its decomposition.
- Incineration or thermal treatment of waste involves heating the waste to burn the organic matter and reduce the other solid mass to ash. The three end-products of incineration are: heat, ash and flue.
- Pyrolysis is the process of thermally and chemically changing the properties of a waste product to make it less harmful to the environment and more suitable for disposal.

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- Compositing is a process in which bacteria and fungi are used to break down organic waste and produce an end-product called compost that has high carbon and nitrogen content along with other nutrients. Compost is used as a natural fertilizer.
- The municipal solid waste management is a process in which waste is collected from localities, sorted into different categories and then treated by techniques suitable for each category by the municipal corporation.
- Recycling of solid wastes implies analysing the sorted wastes to see if any of them can be put into a product or changed in terms of characteristics for reuse.
- The industrial solid waste management is the process of devising and implementing techniques to improve industrial performance by reducing raw material wastage, improving the quality of products and reducing the toxicity of waste.
- The biomedical waste management is the systematic collection, sorting and disposal of hospital waste. Biomedical waste is divided into ten categories and put into colour coded bags for storage, transportation and treatment.
- Ecological sanitation brings together human waste, rain water, grey water and wastewater which can be treated and sent for further use in irrigation, ground restoration, etc.
- The grey water management is the process of managing wastewater from households apart from the one mixed with human waste. It is treated to get cleaner by-products which can be put to further use.
- Hazardous waste is any kind of waste which can cause death, birth defects, illnesses and functional abnormalities in living creatures. Hazardous waste is harmful in all its forms but non-hazardous waste is harmful to the environment only when it is not disposed of correctly.
- Hazardous waste has been carefully classified into eighteen categories. Identification of the source and category of hazardous waste helps trace the cause of its generation and how it can be reduced at the source itself. It also helps in deciding an appropriate method or treatment for its disposal.
- Hazardous waste has four main characteristics which are responsible for causing ill-effects to the humans or surroundings. Any waste which has one or more of these characteristics is categorized as hazardous waste. These characteristics are: flammability, reactivity, corrosiveness and toxicity.
- Quantification of hazardous waste is the estimation of waste production in an area. It helps researchers assess the amount of waste generation from a particular product or process and devise methods to reduce waste generation. Quantification also helps assess the efficiency of the hazardous waste management techniques being used.
- Handling and disposal of hazardous waste is a dangerous process, and thus employees dealing with the same must be educated prepared and well trained.

- Hazardous waste is transported from the generation source to the disposal site. The biggest risk during waste transportation is any kind of waste spill or leak on the way which could endanger a number of lives.
- After its generation, hazardous waste is stored at the source site or disposal site before sending for processing. The containers used for storage need to be well equipped to hold the waste and they should be appropriately coloured or labelled with a statutory warning to create an awareness for anyone dealing with the waste.
- Monthly output of hazardous waste amounting to 100 kilograms or more but less than 1,000 kilograms is termed as small-quantity waste. Small quantity wastes can be stored for up to 180 days and should not be more than 6,000 kilograms at a particular site.
- Monthly output of hazardous waste exceeding 1,000 kilograms is termed as large-quantity waste. These wastes cannot be stored on site longer than 90 days. The industries producing large quantities of waste need to submit the biennial hazardous waste report to the government.
- Disposal of dioxin, PCB and toxins is done through landfills, incineration or chemical treatment. All these methods require prior government approval. Without this approval, a site cannot be used for dioxin, PCB and toxins disposal. And, a site once designated for this purpose cannot be shared with other kinds of waste.
- Infectious hazardous wastes are disposed of using techniques like incineration or autoclaving. This is mainly because high temperatures used in these techniques kill pathogens in infectious hazardous wastes thus preventing the spread of diseases.
- Hazardous waste management in India has been divided into seven steps to ensure adherence to all essential precautions and prerequisites of the process without any hindrance. These steps deal with the production of hazardous waste, its quantification, identifying its nature, finding appropriate disposal sites, transport and storage facilities and disposal procedures.
- Social responsibility of business involves consideration of general public interest by businessmen while taking business decisions and actions.
- According to Earnest Dale, it is the duty of business to provide a fair return to the shareholders, fair working conditions to the employees, fair deal to the suppliers and customers and to make the business an asset to the local community and the nation.
- There are certain limitations of social responsibility. The major limitation is that ethical behaviors or charities under social responsibility usually necessitate financial contributions. This creates a limitation, for instance, a survey was once conducted regarding the limits of social responsibility. They found some managers opining that instead of wasting time on social contributions, it was more feasible to market their products and services.

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## 4.8 KEY TERMS

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- **Biodiversity:** It refers to variation of life forms within a given species, ecosystem, biome, or an entire planet. It can be defined as the variety and diversity that exist among living organisms of all species, genera and ecosystems.
- **Environment management system (EMS):** It is a systematic approach for incorporating environmental goals and priorities into routine operations and managing environmental programs in a planned manner. It is a set of processes and practices that enable an organization to reduce its environmental impacts and helps in achieving environmental goals through consistent control of its operations.
- **Fly ash:** It is the residual ash produced in a combustion process; its particles are very small and thus it can escape with flue gas into the atmosphere.
- **Vermicomposting:** It refers to the process in which worms are added to compost beds to aid in the breakdown process.

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## 4.9 SELF-ASSESSMENT QUESTIONS AND EXERCISES

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### Short-Answer Questions

1. Write a short note on energy resource management.
2. What are the key requirements of an environment management system?
3. What do you understand by voluntary standards in business?
4. What do you understand by ISO 14000?
5. What are the different types of solid waste?
6. Why is composting beneficial?
7. Why is extra care taken while disposing biomedical waste?
8. Why is the quantification of hazardous waste generated in an area necessary?
9. What precautions need to be taken while transporting hazardous waste?
10. Why do hazardous waste disposal sites need government approval?
11. Write a short note on social responsibility.

### Long-Answer Questions

1. Describe the salient features of the various standards comprising the ISO 14000 family.
2. Describe the various principles of environment management according to the International Chamber of Commerce.
3. Analyse the position of ISO standards in the developing world.



4. Describe advantages and disadvantages of incineration.
5. Explain the importance of container labels during transport and storage of hazardous waste.
6. Examine the basic objectives of the hazardous waste management programme in India.
7. Discuss the need for social responsibility for business.

## **NOTES**

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### **4.10 FURTHER READING**

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# UNIT 5 BIODIVERSITY, FOREST MANAGEMENT AND ENVIRONMENTAL ETHICS

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## NOTES

### Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 Biodiversity
  - 5.2.1 Value of Biodiversity
  - 5.2.2 Hotspots of Biodiversity
  - 5.2.3 Threats to Biodiversity and Conservation of Biodiversity
- 5.3 Forest Management
  - 5.3.1 Forest Conservation Act
- 5.4 Environment Ethics
- 5.5 Answers to 'Check Your Progress'
- 5.6 Summary
- 5.7 Key Terms
- 5.8 Self-Assessment Questions and Exercises
- 5.9 Further Reading

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## 5.0 INTRODUCTION

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Biodiversity means the variety and variability of all living organisms. Biodiversity constitutes the biological wealth. Biodiversity is at three levels genetic diversity, species diversity and ecosystem diversity. Conservation, protection and overall management of forests is important. The Forests (Conservation) Act has made ample provisions for conservation and protection of forests and preventing deforestation. This unit will discuss in detail biodiversity and forest management. The importance of environmental ethics will also be explained.

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## 5.1 OBJECTIVES

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After going through this unit, you will be able to:

- Understand the importance of conservation of biodiversity
- Discuss in detail forest management and Forest Conservation Act
- Explain the concept of environmental ethics

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## 5.2 BIODIVERSITY

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'Biological diversity', as defined by the Convention on Biodiversity, 1992, means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

## NOTES

Biodiversity functions in three levels: genetic biodiversity, species biodiversity, and ecosystem biodiversity.

### 1. Genetic Biodiversity

It is the basic source of biodiversity. Genes found in organisms can form enormous number of combinations, each of which gives rise to some variability. Genes are the basic units of hereditary information, transmitted from one generation to other. When the genes within the same species show different versions, due to new combinations, it is called genetic variability. For example, all rice varieties belong to the species *Oryza sativa*, but there are thousands of wild and cultivated varieties of rice which show variations at the genetic level and differ in their colour, size, shape, aroma and nutrient content of the grain. This is genetic diversity of rice.

Genetic biodiversity means the variation of genes within a species. In a species, each variety has its own genes or genetic make-up. Diversity of genes within a species increases its ability to adapt to diseases, pollution and other changes in the environment. When a variety of a species is destroyed, genetic diversity gets diminished.

### 2. Species Biodiversity

This is the variability found within the population of a species or between different species of a community. It represents broadly the species richness and their abundance in a community.

Till now, only about 1.5 million living and 300000 fossil species have been actually described and given scientific names. It is quite likely that a large fraction of these species may have become extinct even before they were discovered and enlisted.

Species biodiversity means a variety of species within a region. Such diversity can be measured on the basis of species in a region. More the species biodiversity means more the biological wealth.

### 3. Ecosystem Biodiversity

This is the diversity of ecological complexity showing variations in ecological niches, trophic structure, food webs, nutrient cycling, etc. Ecosystems also show variations with respect to physical parameters like moisture, temperature, altitude and precipitation. Thus, there occurs tremendous diversity within the ecosystems, along these gradients.

We mainly consider diversity in forest ecosystem, which is supposed to have a dominance of trees. While considering a tropical rainforest, a tropical deciduous forest, a temperate deciduous forest and a boreal forest, the variations observed are too many and they are mainly due to variations in these physical factors.

Ecosystem diversity is of great value that must be kept intact. This diversity has developed over millions of years of evolution. If we destroy this diversity, it would disrupt the ecological balance. We cannot replace the diversity of one ecosystem with that of another. Coniferous trees of boreal forests cannot take up the function of the trees of tropical deciduous forest lands and vice versa, because

ecosystem diversity has evolved with respect to the prevailing environmental conditions with well-regulated ecological balance.

Ecosystem biodiversity refers to the variety of ecosystem in a particular region or zone, for example, various ecosystems include forests, wetlands, arid zones and deserts. All these have their own fauna and flora (biodiversity).

## NOTES

### 5.2.1 Value of Biodiversity

Biodiversity in terms of its commercial utility, ecological service, social and aesthetic value has enormous importance. We are benefited by other organisms in innumerable ways. Sometimes, we come to know and appreciate the value of an organism only after it is lost from this earth. Very small, insignificant, useless looking organism may play a crucial role in the ecological balance of the ecosystem or may be a potential source of some invaluable drug for dreaded diseases like cancer or AIDS. The multiple uses of biodiversity is classified as follows:

#### Consumptive Use Value

These include direct use values where the biodiversity product can be harvested and consumed directly, e.g., fuel, food, drugs and fibre.

**Food:** A large number of wild plants and shrubs are consumed by human beings as food. About 80,000 edible plants species have been reported from the wild. About 90 per cent of present day food crops have been domesticated from wild tropical plants. Even now, our agricultural scientists make use of the existing wild species of plants that are closely related to our crop plants for developing new hardy strains. Wild relatives usually possess better tolerance and hardiness. A large number of wild animals are also our sources of food.

**Drugs and medicines:** About 75 per cent of the world's population depends upon plants or plant extracts for medicines. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium. Likewise, we get tetracyclin from a bacterium. Quinine, the cure for malaria is obtained from the bark of cinchona tree, while digitalin is obtained from foxglove (*digitalis*) which is an effective cure for heart ailments. Recently, vinblastin and vincristine, two anti-cancer drugs, have been obtained from periwinkle (*catharanthus*) plant, which possesses anti-cancer alkaloids. A large number of marine animals are supposed to possess anti-cancer properties which are yet to be explored systematically.

**Fuel:** Our forests have been used since ages for fuel wood. The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity. Firewood collected by individuals are not normally marketed, but are directly used by tribals and local villagers; hence, falls under constructive value.

#### Productive Use Values

These are the commercially usable values, where the product is marketed and sold. It may include lumber or wild gene resources that can be traded for use by scientists for introducing desirable traits in the crops and domesticated animals. These may also include animal products like tusks of elephants, musk from musk deer, silk from silkworm, wool from sheep, fur of many animals and lac from lac insects, all of which are traded in the market. Many industries are dependent upon

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the productive use of values of biodiversity, e.g., paper and pulp industry, plywood industry, railway sleeper industry, silk industry, textile industry, ivory-works, leather industry, pearl industry, etc.

Despite international ban on trade in products from endangered species, fur, hide, horns, tusks, live specimen, etc., worth millions of dollars are being sold every year. Developing countries in Asia, Africa and Latin America are the richest biodiversity centres and wildlife products are smuggled and marketed in large quantities to some rich western countries and also to China and Hong Kong, where export of animal skins and snake skins is a booming business.

### **Social Value**

These are the values associated with the social life, customs, religion and psycho-spiritual aspects of the people. Many of the plants are considered holy and sacred in our country like tulsi(holy basil), peepal, mango, lotus and bael. The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped. The tribal people are closely linked with the wildlife in the forest. Their social life, songs, dances and customs are closely woven around the wildlife. Many animals like cow, snake, bull, peacock and owl, also have a significant place in our psycho-spiritual arena and thus, hold special social importance. Thus, biodiversity has distinct social value, attached with different societies.

### **Ethical Value**

It is also sometimes known as existence value. It involves ethical issues like 'all life must be preserved'. It is based on the concept of 'live and let live'. If we want our human race to survive, then we must protect all biodiversity, because biodiversity is valuable.

Ethical value means that we may or may not use a species, but knowing the fact that these species exists in nature gives us pleasure. We all feel sorry when we learn that 'passenger pigeon' or 'dodo' is extinct. We are not deriving anything directly from the kangaroo, zebra or giraffe, but we all strongly feel that these species should exist in nature. This means, there is an ethical value or existence value attached to each species.

### **Aesthetic Value**

Great aesthetic value is attached to biodiversity. None of us would like to visit vast stretches of barren lands with no signs of visible life. People from far and wide spend a lot of time and money to visit wilderness areas, where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as ecotourism. The 'willingness to pay' concept on such ecotourism gives us even a monetary estimate for aesthetic value of biodiversity. Ecotourism is estimated to generate about 12 billion dollars of revenue annually, this roughly gives the aesthetic value of biodiversity.

### **Option Value**

These values include the potential of biodiversity that are presently unknown and need to be explored. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depths of a marine ecosystem or a tropical rainforest.

Thus, option value is the knowledge that there are biological resources existing on this biosphere that may one day prove to be an effective option for something important in the future. Thus, the option value of biodiversity suggests that any species may prove to be a miracle species someday. Biodiversity is like precious gifts of nature presented to us. We should not commit the folly of losing these gifts even before unwrapping them.

Option value also includes the values, in terms of the option to visit areas where a variety of flora and fauna, or specifically some endemic, rare or endangered species exist.

### **Ecosystem Service Value**

Recently, a non-consumptive use value related to self-maintenance of the ecosystem and various important ecosystem services has been recognized. It refers to the services provided by the ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, fixation of nitrogen, cycling of water, their role as carbon sinks, pollutant absorption and reduction of the threat of global warming, etc.

Different categories of biodiversity value clearly indicate that ecosystem, species and genetic diversity all have enormous potential, and a decline in the biodiversity will lead to huge economic, ecological and socio-cultural losses.

### **5.2.2 Hotspots of Biodiversity**

Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity. Species which are restricted only to particular areas are known as **endemic**. India shows a good number of endemic species. About 62 per cent of amphibians and 50 per cent of lizards are endemic to India. Western Ghats are the site of maximum endemism. The term 'Hot spots' was introduced by Myers (1988). There are twenty-five such hot spots of biodiversity on a global level, out of which two are present in India, namely the Eastern Himalayas and the Western Ghats.

These hot spots covering less than 2 per cent of the world's land area are found to have about 50 per cent of the terrestrial biodiversity. According to Myers, an area is designated as a hot spot when it contains at least 0.5 per cent of the plant species as endemics.

- (a) **Eastern Himalayas:** They display an ultra-varied topography that fosters species diversity and endemism. Recent studies have shown that North East India along with its contiguous regions of Burma and Chinese provinces of Yunnan and Schezwan is an active centre of organic evolution and is considered to be the cradle of flowering plants. Out of the world's recorded flora, 30 per cent are endemic to India of which 35000 are in the Himalayas.
- (b) **Western Ghats:** It extends along a 17,000 km strip of forests in Maharashtra, Karnataka, Tamilnadu and Kerala and has 40 per cent of the the total endemic plant species. The major centres of diversity are Agastyamalai Hills and Silent Valley– the new Amambalam Reserve Basin. It is reported that only 6.8 per cent of the original forests are existing today, while the rest have been deforested or degraded, which raises a serious

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cause of alarm, because it means we have already lost a huge proportion of the biodiversity.

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### 5.2.3 Threats to Biodiversity and Conservation of Biodiversity

Extinction or elimination of a species is a natural process of evolution. In the geologic period, earth has experienced mass extinctions. During evolution, species have died and have been replaced by others. However, the rate of loss of species in the geologic past has been a slow process, keeping in view the vast span of time going back to 444 million years. The process of extinction has become particularly fast in the recent years of civilization. In the recent times, the human impact has been so severe that thousands of species and varieties are becoming extinct annually. One of the estimates puts the figure of extinction at 10,000 species per year or twenty-seven per day. These figures raise an alarm regarding the serious threat to biodiversity. Over the last 150 years, the rate of extinction has escalated more dramatically. If the present trend continues, we would lose one-third to two-third of our current biodiversity by the middle of the twenty-first century.

#### Threats to Biodiversity

The following are the major causes and issues related to threats to biodiversity:

#### Loss of Habitat

Destruction and loss of natural habitat is the single largest cause of losing own biodiversity. Billions of hectares of forests and grasslands have been cleared over the past 10,000 years for conversion into agricultural lands, pastures, settlement areas or development projects. These forests and grasslands were the homes of thousands of species, which perished due to loss of their natural habitat. Severe damage has been caused to wetlands, thinking them to be useless ecosystems. The unique and rich biodiversity of the wetlands, estuaries and mangroves are under serious threat today. The wetlands are destroyed due to draining, filling and pollution, thereby causing huge loss of biodiversity.

The habitat is divided into small and scattered patches, so that the complete loss of habitat can be put at bay. This phenomenon is known as habitat fragmentation. There are many wildlife species such as bears and large cats that require large territories to subsist. They are threatened as they breed only in the interiors of the forests. Due to habitat fragmentation, many song birds are becoming extinct.

There has been a rapid disappearance of tropical forests in our country, at the rate of about 0.6 per cent per year. With the current rate of loss of forest habitat, it is estimated that 20-25 per cent of the global flora would be lost within a few years. Marine diversity is also under serious threat due to large-scale destruction of the fragile breeding and feeding grounds of fish and other species.

#### Poaching

Illegal trade of wildlife products by killing prohibited endangered animals, i.e., poaching is another threat to wildlife. Despite international ban on trade in products



from endangered species, smuggling of wildlife items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year, continues. The developing nations in Asia, Latin America and Africa are the richest source of biodiversity and have enormous wealth of wildlife. The rich countries in Europe and North America and some affluent countries in Asia like Japan, Taiwan and Hong Kong are the major importers of wildlife products or wildlife itself.

The trading of such wildlife products is highly profitable for the poachers who smuggle them to other countries mediated through mafia. The worst part is that for every live animal that actually gets into the market, about fifty additional animals are caught and killed.

If you are fond of rare fishes or birds, please make sure that you are not going to harm the **endangered species** or wild-caught species. Doing so will help in checking further decline of these species. Also, do not purchase fur coat, purse or bag, or items made of crocodile skin or python skin. You will certainly help in preserving biodiversity by doing so.

### **Man and wildlife conflict**

Conflict between people and animals is one of the main threats to the continued survival of many species in different parts of the world, and is also a significant threat to local human populations. If solutions to conflicts are not adequate, local support for conservation also declines.

As human populations expand and natural habitats shrink, people and animals are increasingly coming into conflict over living space and food.

People lose their crops, livestock, property, and sometimes their lives. The animals, many of which are already threatened or endangered, are often killed in retaliation or to 'prevent' future conflicts.

The solutions are often specific to the species or area concerned, and are often creative and simple.

An important aspect of the work is that it benefits both the animals and local human communities, and actively involves these communities. This is about finding solutions that lead to mutually beneficial co-existence.

The work has also often led to people being more enthusiastic and supportive of conservation, and has demonstrated that people can live alongside wildlife while developing sustainable livelihoods.

### **Endangered, Endemic and Exotic Species of India**

Let us first discuss the endangered species of India.

#### **Endangered Species of India**

Critically endangered is the highest risk category assigned by the IUCN (International Union for Conservation of Nature) to wild species.

A taxon is critically endangered when the best available evidence indicates that it meets any of the following criteria:

- I. Populations have declined or will decrease, by greater than 80 per cent over the last ten years or three generations.

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- II. Have a restricted geographical range.
- III. Small population size of less than 250 individuals and continuing decline at 25 per cent in three years or one generation.
- IV. Very small or restricted population of fewer than fifty mature individuals.
- V. High probability of extinction in the wild.

Examples of endangered species in India include birds like Jerdon's Courser (*Rhinoptilus bitorquatus*), Forest Owlet (*Heteroglaux blewitti*), White-bellied Heron (*Ardea insignis*) etc.; mammals include Pygmy Hog (*Porcula salvania*), Andaman White-toothed Shrew (*Crocidura andamanensis*), Namdapha Flying Squirrel (*Biswamoyopterus biswasi*) etc.; reptiles like Gharial (*Gavialis gangeticus*), Hawksbill Turtle (*Eretmochelys imbricata*) etc.

### Endemic Species of India

Endemic species refers to species of plants and animals which exist naturally only in a particular geographical region. The region can be as small as an island or as large as a continent. They are unique and indigenous to their location.

Examples of endemic species in India include South Indian Tree Shrew, Lion-tailed Macaque, Nilgiri Langur, Nicobar flying fox, Madras hedgehog among others.

### Exotic species

Animals and plant species introduced whether intentionally or accidentally from other countries, which are not otherwise found locally are termed exotic species. These introduced or exotic species can adversely affect the ecosystem by acting as invasive species affecting the local endemic population.

The biggest problem of exotic species is when they turn into weeds and multiplying incredibly fast adversely affecting the ecosystem, for e.g. water hyacinth and lantana.

The reason for the growth and spread of exotics is that they are invariably introduced without their natural enemies that should control and balance their spread in their native land, and hence, unhindered the exotic species grow and flourish, leaving bad consequences to the local ecosystem.

While the exotic species are selected specifically for their quality of adaptability in the long run, they commonly outnumber the native species and compete with them for the resources. This is bad for the native species who now because of additional competition suffer and ultimately decline in numbers.

But the negative or positive effect of the introduction of an exotic species differs from species to species. Examples of exotics introduced in India include vegetables like chillie and the onion, which have been brought from South America and Persia (modern day Iran) respectively.

Some quick growing plant species were brought from Australia for afforestation programmes such as the acacia and the eucalyptus. The demand for wood in different industries led to a growth of forest area under these species. The introduction of these species has caused more harm than good to the forests and the soil in general.

Some weeds have not been intentionally introduced but have come accidentally, for instance the Mexican weed came along with American wheat that came as PL480

aid from the USA in the 1960s when quarantine rules were not so strict.

A measure to control the effect of exotic species on native species is through the process of quarantine. All the plants and seeds that come from another country should be quarantined to ensure that no other foreign material has come with it. Quarantine facilities must be made available at all entry and exit points, at the airports, border crossing on land and the harbours. This will prevent further damage, and the existing plants and animals can then and should be allowed to flourish in their natural surroundings and habitat.

### **Conservation of Biodiversity**

Due to the tremendous importance of biodiversity it is considered an asset of a region or a nation. Due to its multiple advantages of commercial value, consumption value, medicinal value, social, cultural, religious and optional values, biodiversity needs to be conserved. The need for its protection and conservation has become more important due to overexploitation and the subsequent depletion. There are two types of methods of conservation of biodiversity:

1. Ex-situ
2. In-situ

Ex-situ conservation means off-site protection of biodiversity. It is the process of protecting an endangered species of plant or animal by removing it from an unsafe or threatened habitat and placing it under human care.

While Ex-situ conservation comprises some of the oldest and best-known techniques known to and created by man, it also involves newer techniques like laboratory method.

### **Methods of Ex-Situ Conservation**

Creation of zoos, botanical gardens, culture collection centres are the most conventional and traditional methods of ex-situ conservation, all of which house and protect specimens for breeding and reproduction of wild life animals and plants. Endangered plants may also be preserved in part in such botanical garden through seed banks and germplasm banks.

Endangered animals are preserved using similar techniques through preservation in gene bank.

In the gene banks, which consist of cryogenic facilities, live sperms, eggs or embryos can be stored. Some countries have established frozen zoos to store such samples from more than 366 species, which consist of mammals, reptiles and birds.

### **Drawbacks of ex-situ conservation**

Ex-situ conservation although is helpful to man's effort to sustain and protect biodiversity, is rarely enough to save a species from extinction. It can be used as a last resort or as a supplement to in-situ conservation. It cannot re-create a habitat. Furthermore, ex-situ conservation techniques are often costly.

### **In-situ Conservation**

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In-situ conservation means to conserve the biodiversity within the habitat and on site. It is a process of protecting an endangered species of plant or animal in its natural habitat, either by protecting or preventing the habitat itself from being depleted.

The benefit of in situ conservation is that it maintains the natural surroundings of the population of the animals or plant in its natural distinctive property.

In situ conservation should be preferred to ex situ conservation, the latter opted only in case where in situ conservation is either too difficult or impossible. Wildlife conservation is mostly based on in situ conservation through protection and recreation of the wildlife habitat.

### Wildlife Protection Act

The major activities and provisions in the Act can be summed up as follows:

1. It defines the wildlife related terminology.
2. It provides for the appointment of wildlife advisory board, wildlife warden, their powers, duties, etc.
3. Under the Act, comprehensive listing of endangered wildlife species was done for the first time and prohibition of hunting of the endangered species was mentioned.
4. Protection to some endangered plants.
5. The Act provides for setting up of national parks, wildlife sanctuaries, etc.
6. The Act provides for the constitution of central zoo authority.
7. There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer, etc.
8. The Act imposes a ban on the trade or commerce in scheduled animals.
9. It provides for legal powers to officers and punishment to offenders.
10. It provides for captive breeding programme for endangered species.

Several conservation projects for individual endangered species like Lion (1972), Tiger (1973), Crocodile (1974) and Brown antlered Deer (1981) were stated under this Act. The Act is adopted by all states in India except J & K, which has its own Act.

Some of the major drawbacks of the Act include mild penalty to offenders, illegal wildlife trade in J & K, personal ownership certificate for animal articles like tiger and leopard skins, no coverage of foreign endangered wildlife, pitiable condition of wildlife in mobile zoos and little emphasis on protection of plant genetic resources.

### Check Your Progress

1. What are the three levels of biodiversity?
2. What is habitat fragmentation?
3. Name the two types of methods of conservation of biodiversity.
4. Define exotic species.

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## 5.3 FOREST MANAGEMENT

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A forest is a complex ecosystem which is predominantly composed of trees, shrubs and is usually a closed canopy. Forests are storehouses of a large variety of life forms such as plants, mammals, birds, insects and reptiles etc. Also the forests have abundant microorganisms and fungi, which do the important work of decomposing dead organic matter thereby enriching the soil. Nearly 4 billion hectares of forest cover the earth's surface, roughly 30 per cent of its total land area.

The forest ecosystem has two components — the non-living (abiotic) and the living (biotic) component. Climate, soil type are part of the non-living component and the living component includes plants, animals and other life forms. Plants include the trees, shrubs, climbers, grasses and herbs in the forest. Depending on the physical, geographical, climatic and ecological factors, there are different types of forests like evergreen forest (mainly composed of evergreen tree species i.e. species having leaves throughout the year) and deciduous forest (mainly composed of deciduous trees i.e. species having leaf-fall during particular months of the year). Each forest type forms a habitat for a specific community of animals that are adapted to live in it.

The term forest implies 'natural vegetation' of the area, existing from thousands of years and supporting a variety of biodiversity, forming a complex ecosystem. Plantation is different from natural forest as these planted species are often of the same type and does not support a variety of natural biodiversity. Forests provide various natural services and products. Many forest products are used in day-to-day life. Besides these, forests play important role in maintaining the ecological balance and contributes to economy as well.

### **Ecological Role of Forest**

- Forests provide an environment for many species of plants and animals and thus, protects and sustains the diversity of nature.
- Plants provide habitat to different types of organisms. Birds build their nests on the branches of trees, animals and birds live in the hollows, insects and other organisms live in various parts of the plant.
- Forests act as hydrologic flow modulators.
- Plants provide a protective canopy that lessens the impact of raindrops on the soil, thereby reducing soil erosion. Roots help to hold the soil in place. They provide shade which prevents the soil from becoming too dry. This increases the moisture holding capacity of the soil.
- Forests help in maintaining microclimate of the area.
- Plants clean the air, cool it on hot days, conserve heat at night, and act as excellent sound absorbers. Transpiration from the forests affects the relative humidity and precipitation of a place. Forests clean the environment by muffling noises, buffering strong winds and preventing dust and gases.
- The layer of leaves that fall around the tree prevents runoff and allows the water to percolate into the soil. Thus, helping in groundwater recharge.

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- Dead plants decompose to form humus, organic matter that holds the water and provides nutrients to the soil.
- Through the process of photosynthesis, forests renew the oxygen supply in the atmosphere by absorbing atmospheric carbon dioxide and moderating the greenhouse effect.

As per the report published by Ministry of Environment and Forests during August 2009, the annual CO<sub>2</sub> removal by India's forest and tree cover is enough to neutralize 11.25 per cent of India's total GHG emissions (CO<sub>2</sub> equivalent) at 1994 levels. This is equivalent to offsetting 100 per cent emissions from all kinds of energy in residential and transport sectors; or 40 per cent of total emissions from the agriculture sector. Clearly, India's forest and tree cover is serving as a major mode of carbon mitigation for India and the world.

- Forest cover of an area plays an important role in the amount of precipitation received by the area. Thus playing an important role in maintaining the water cycle of the area.
- Some species of trees have the ability to return nitrogen to the soil through root decomposition or fallen leaves. Such trees are planted to increase the nitrogen content of the soil.
- Forests absorb suspended particles in air which helps in reducing pollution.
- Forests also help in the process of soil formation by causing weathering of rock
- They play vital role in maintaining healthy watershed. Rivers that originate in a forest area carry the organic matter from forest to the downstream. This helps to support a variety of fishes and aquatic animals. The richness of forest in upstream decides the biological value of the river ecosystem supported by it.
- Forests provide forest food which has great medicinal value and used by local people.

In performing all these functions, forest stabilizes the climate, maintains the ecological/environmental balance of the area and shapes the landscape of the area.

### Contribution to Economy

- Forest provides valuable items like timber, paper, fuel wood, bamboo, cane, food, fibers, essential oils, etc.
- Forest plants provide hundreds of medicinal plants, spices, poisons, insecticides, soap substitutes like *ritha* and *shikakai*, *tendu* leaves used in *bidi* wrapping, etc.
- Forests also provide fodder for cattle and other grazing animals. Leaves and twigs of some plants have high fodder value. It is useful fodder source during drought.
- Forests are also popular areas for relaxation and recreation and they add to the aesthetic value of the area.

## **Classification of Forests**

Forests can be classified in different ways. The forest type depends upon the abiotic factors such as climate and soil characteristics of a region. Forests in India can be broadly divided into coniferous forests and broadleaved forests. They can also be classified according to the nature of their tree species—evergreen, deciduous, xerophytes or thorn trees, mangroves, etc. They can also be classified according to the most abundant species of trees, such as Sal or Teak forests. In many cases, a forest is named after the first three or four most abundant tree species.

- **Coniferous forests** grow in the Himalayan mountain region, where the temperatures are low. These forests have tall trees with needle-like leaves and downward-sloping branches, so that the snow can slip off the branches.
- **Broad-leaved forests** are of several types, such as evergreen forests, deciduous forests, thorn forests, and mangrove forests. Broad-leaved trees usually have large leaves of various shapes and are found in middle to lower latitude.
- **Evergreen forests** grow in the high rainfall areas of the Western Ghats, Northeastern India and the Andaman and Nicobar Islands. These forests grow in areas where the monsoon period lasts for several months.
- **Deciduous forests** are found in regions with a moderate amount of seasonal rainfall that lasts for only a few months. Most of the forests in which Teak trees grow are of this type. The deciduous trees shed their leaves during the winter and hot summer months.
- **Thorn forests** are found in the semi-arid regions of India. The trees, which are sparsely distributed, are surrounded by open grassy areas.
- **Mangroves forests** grow along the coast especially in the river deltas. These plants are uniquely adapted to be able to grow in a mix of saline and freshwater. They grow luxuriantly in muddy areas covered with silt that the rivers have brought down. The mangrove trees have breathing roots that emerge from the mud banks.

## **Threats to Forests**

As the rate of development is increasing, it is putting pressure on all the natural resources around us. Forests are also getting depleted at a fast rate all over the world.

Over use and irrational use, technological and industrial growth, population growth and increasing consumption levels are major factors causing depletion of forest resources. Some other factors are mining, submergence due to big dams, shifting cultivation, use of forestlands for rehabilitation, agriculture, transport and tourism. All these activities are causing qualitative as well as quantitative depletion of forests. The forest wood is used up for construction, furniture, deriving energy (coal and firewood) and thus the increasing demand for timber, energy, paper and paper products has led to massive destruction of forests.

When forest is cut, it is not just the trees that go but the entire ecosystem is lost which is invaluable. The full grown forests, existing since thousands of years

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cannot be replaced by plantations. As forests grow very slowly, people cannot use more resources than they can produce during a growing season. If timber is felled beyond a certain limit, the forest cannot regenerate.

The gaps in the forest change the habitat quality for its animal, and the more sensitive species cannot survive under these changed conditions. Over-utilizing forest resources is an unsustainable way of using our limited forest resources. As the forest resources are exploited, the forest canopy is opened up, the ecosystem is degraded, and its wildlife is seriously threatened.

**Increasing tourism activities** are also causing destruction to forest ecosystem. When the frequency of visitors and tourists becomes excessive, problems of soil erosion occur along and adjacent to footpaths. Wildlife is also disturbed, plants and saplings are trampled, and the waste is dumped at these places which disturbs the entire ecosystem.

**Forest fire** is also an important threat to forests, which destroys large areas of forest every year all over the world. It has detrimental impact on forest, wildlife and people living around. Along with the loss of biodiversity, it results in increased air pollution, migration of animals to different areas. It directly affects the livelihood of people dependant on forest resources.

**Natural disasters** like Tsunami, and earthquake destroys large forests areas in a short span of time.

All these natural as well as man-made factors cause destruction of forests on a large scale.

### Forest Management

Conservation, protection and overall management of forests are important. Entities involved in it and their role can be summarized as follows:

- Government
- Community and community organizations
- Individuals and Private Bodies

Let us discuss these entities in detail.

- 1. Government:** Making policy and laws for conservation, protection and overall management of resources is one of the important aspects of government initiatives. India's first Forest Policy was enunciated in 1952. Between 1952 and 1988, the extent of deforestation was so great that it became essential to formulate a new policy on forests and their utilization. The earlier forest policies had focused only on revenue generation. In the 1980s it became clear that forests must be protected for their other functions such as the maintenance of soil and water regimes centered on ecological concerns. Thus, the role of India's forests in the national economy and ecology has been reemphasized in the National Forest Policy, 1988, which focuses on ensuring environmental stability, restoring the ecological balance and preserving the forests. The policy aims at increasing the forest and tree cover to 33 per cent of the country's land area. It also provided for the use of goods and services of the forest for its local inhabitants.



Various laws like Forest Conservation Act, Wildlife Protection Act have been prepared and are being implemented by the government. The Forest Conservation Act of 1980 was enacted to control deforestation. In 1988, this act was amended to facilitate stricter conservation measures. Under the Wildlife Protection Act, 1972, different animals are categorized under specific schedules and there are restrictions on their hunting. As per this act specific ban is imposed on hunting of all Schedule 1 animals like tigers, leopards etc.

Another important government initiative is declaration of protected areas for conservation of wildlife. Sanctuaries and National Parks play a very important role in conservation of plants and animal gene pool. Several of these are present in catchment areas of major rivers, and so they are very important for water conservation and conservation of entire ecosystem. The government also implements many schemes for conservation of forests and for their sustainable management.

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### **Maharashtra Forest Policy, 2008**

Maharashtra State has prepared the 'Maharashtra Forest Policy, 2008' with focus on 'Sustainable management of forests and wildlife in the State'. The policy also focuses on formulation of District wise plan for achieving 33 per cent of forest cover in the State.

#### **Some of the objectives of the policy**

- To achieve sustainable development and conservation of forests through their scientific management, this will help in maintaining ecological balance and environmental stability.
- Afforestation on wastelands for soil and water conservation
- To increase forest cover on available government, public and private lands through participation of women and unemployed people, with the help of Social Forestry and Agricultural nurseries.
- Implementing long term plans and action plans for Conservation of wildlife and biodiversity.
- Management of Catchment areas for soil conservation
- Joint Forest Management
- Eco-tourism policy
- Reduction in use of timber and other forest produce
- Establishing Forest Development Corporation of Maharashtra (FDCM)

#### **Working Strategies**

##### **1. Afforestation through Social / Community Forestry**

- Afforestation will be done on wastelands and saline soils. Trees for firewood, fodder and NTFP (non-timber forest produce) will be planted. The work will be done through Social / Community Forestry with involvement of local people.

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- Land near railway tracks, state and national highways, canals will be used for plantations.
- Green belts will be developed in urban and industrial areas to absorb carbon dioxide from the atmosphere and control the pollution. Urban forestry will be promoted on available areas in cities like gardens, open spaces, with the help of technical support from FDCM and Social Forestry.
- Village lands and community lands will be brought under afforestation to meet the increasing demand for timber, firewood and NTFP. This work will be undertaken with involvement of *Grampanchayat* and with technical help from Social Forestry Department.
- Organizations and individuals will be promoted to do tree farming on their land by providing necessary facilities and bringing required changes in Land Acquisition Rules and related rules, if any.

### 2. Community and Community Organizations

Community organizations are at the interface of government and individuals. Community participation is a very important aspect in implementation of resource management programmes.

Communities take various initiatives for conservation—like Sacred Groves. These are forest patches protected for religious or cultural reasons. It is an excellent example of community conservation. Many of these groves are at the origin of rivers, thus helping in water conservation.

It also protects rare varieties of plants and animals. India has over 19,000 sacred groves. All these areas are also being disturbed due to increasing pressure on available land resource, so they need to be conserved. There are many examples of communities' role in conservation of forests e.g. the Chipko Movement and *Bishnois* in Rajasthan.

#### The Chipko Movement

The 'Chipko movement' was started around 260 years back in the early 18th century in Rajasthan by the *Bishnoi* community. The name of the movement comes from the word 'embrace', as the villagers hugged the trees, and prevented the contractors from felling them. A large group of them from 84 villages led by a lady called Amrita Devi laid down their lives in an effort to protect the trees from being felled on the orders of the Maharaja of Jodhpur. After this incident, the maharaja gave a strong royal decree preventing the cutting of trees in all Bishnoi villages.

In the 20th century, this movement began in the hills where the forests are the main source of livelihood, since agricultural activities cannot be carried out easily. The Chipko Movement of 1973 was one of the most famous among these, which was initiated in the village of Mandal in the upper Alakananda valley and over the next five years spread to many districts of the Himalayas in Uttar Pradesh. It was sparked off by the government's decision to allot a plot of forest area in the Alaknanda valley to a sports goods company. This angered the villagers because their similar demand to use wood for making agricultural tools had been earlier denied. With encouragement from a local NGO, DGSS (Dasoli Gram Swarajya Sangh), the women of the area, under the leadership of an activist, Chandi Prasad

Bhatt, went into the forest and formed a circle around the trees preventing the men from cutting them down. The success achieved by this protest led to similar protests in other parts of the country.

### **The Bishnois**

The *Bishnois*, a Vaishnavite sect, living in western Rajasthan on the fringe of the Thar Desert, have for centuries, been conserving the flora and fauna to the extent of sacrificing their lives to protect the environment. For these nature-loving people, protection of the environment, wildlife, and plants is a part and parcel of their sacred traditions. The basic philosophy of this religion is that all living things have a right to survive and share all resources.

In the fifteenth century, Swami Jambheshwar Maharaj laid down 29 tenets for his followers which included a ban on killing animals, a ban to felling of trees (especially the *Khejri* – which grows extensively in these areas). Nature protection was given foremost importance in these tenets. Since then, the sect has religiously followed these tenets. The heartland of the *Bishnois* in the forests near Jodhpur is abundant in trees and wildlife. The landscape around here is greener than elsewhere and the animals mainly antelopes, particularly the blackbuck and the chinkara, in these forests are not afraid of humans and are often seen near the villages eating out of the hands of the villagers. The Bishnois have indeed proved that human lives are a small price to pay to protect the wildlife and the forests around them.

### **3. Individuals and Private Bodies**

Many individual efforts have led to conservation of tree cover in a particular area. Some people have carried out successful restoration activities on many acres of land for the revival of forest ecosystem. There are also examples of people who have done plantations of variety of tree species on their land, which has helped maintain green cover of the area.

#### **Major Activities in Forests**

- **Timber extraction:** The activity of extracting precious timber from the forests such as Teak and Mahogany involves both a few large trees per hectare and a dozen more trees since they are strongly interlocked with each other by vines etc., and construction of roads in forest causes further destruction of forests.
- **Mining:** Extraction of minerals and fossil fuels such as coal is carried out in extensive forest areas. Minerals from shallow deposits are extracted through surface mining, while that from deep deposits is done by sub-surface mining. In India, more than 80,000 ha of land is currently subject to mining activities. Mining and its associated activities necessitate the removal of vegetation along with the primary layer of soil and overlying rock masses. As a result, the topography gets spoilt and the landscape in the area gets ruined.

Extensive deforestation has been registered in Mussorie and Dehradun valley on account of arbitrary mining of various minerals over an area of approximately forty kilometres. The forested area has reduced at a standard rate of 33 per cent and the growth in non-forest area due to mining activities has created moderately unbalanced zones, leading to landslides.

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Since 1961 random mining in the forests of Goa has wiped out more than 50,000 ha of forest land. Coal mining in Jharia, Raniganj and Singrauli areas has resulted in large-scale deforestation in Jharkhand. Mining of magnetite and soap-stones have destroyed 14 ha of forest in hill slopes of Khirakot, Kosi valley, Almora. Mining of radioactive minerals in Kerala, Tamil Nadu and Karnataka are putting up related fears of deforestation. The luxurious forests of Western Ghats are also confronting a similar risk due to mining proposals for excavation of copper, chromite, bauxite and magnetite.

- **Mining Engineering:** Mining Engineering is a field that involves other engineering disciplines as applied to extracting and processing minerals from a naturally occurring environment.

A technologically advanced society certainly deals in mineral extraction and production. As minerals are produced from within the natural environment, they are bound to disturb the environment. Hence, modern mining engineers must ensure that minimal damage or modifications are made to the environment as a result of mineral processing and production.

The two main kinds of mine are underground mines and open-pit mines. Minerals that exist moderately deep underground (e.g., some coal seams, gold and some metalliferous ores) are usually recovered using underground mining methods. Minerals like iron ore, shallow coal seams and bauxite are generally recovered from the surface by open pit mining.

### **Dams and their Effects on Forests and People**

Big dams and rivers valley projects have multi-purpose uses and Pandit Jawaharlal Nehru used to refer to these dams and valley projects as ‘Temples of modern India’. However, these dams are also accountable for the devastation of vast areas of forests. More than 1550 large dams have been constructed in India, the maximum being in the state of Maharashtra (more than 600), followed by Gujarat (more than 250) and Madhya Pradesh (130). The highest one is Tehri Dam, on river Bhagirathi in Uttarakhand and the largest in terms of capacity is the Bhakra Dam on river Satluj in Himachal Pradesh.

Numerous environmental groups across the globe have been focusing on the construction of large dams as their construction requires the cutting down of trees which further creates several socio-economic problems for the natives of the hilly regions.

For instance, the Silent Valley Hydro-Electric Project situated in the tropical rain forest area of Western Ghats, was one of the earliest projects which drew attention of the people.

The leader of Chipko Movement, Shri Sunderlal Bahaguna, vehemently led the campaign against the ecological damage and deforestation caused due to Tehri Dam. Similarly, several environmental issues related to Sardar Sarovar Dam were campaigned by the environmental activist Medha Patkar, joined by Arundhati Roy and Baba Amte.

The construction of large-scale dams requires cutting down of trees and leads to devastation of precious species which could be possessing medicinal

properties and hence could be used in saving lives. Not only this, the ecological balance of the region gets broken which further leads to natural disasters such as floods, droughts and landslides.

### **5.3.1 Forest Conservation Act**

This Act deals with the conservation of forests and related aspects. Except for J & K, the Act is adopted all over India. The Act covers under it, all types of forests including reserved forests, protected forests or any forested land irrespective of its ownership.

The salient features of the Act are as follows:

1. The state government has been empowered under this Act to use the forests only for forestry purposes. If at all it wants to use it in any other way, it has to take prior approval of the central government, after which it can pass orders for declaring some part of reserve forest for non-forest purposes (e.g. mining) or for clearing some naturally growing trees and replacing them by economically important trees (reforestation).
2. It makes a provision for conservation of all types of forests and for this purpose there is an advisory committee which recommends funding for it, to the central government.
3. Any illegal non-forest activity within a forest area can be immediately stopped under this Act.

Non-forest activities include clearing of forest land for cultivation of any type of plants/crops or any other purpose (except re-afforestation). However, some construction work in the forest for wildlife or forest management is exempted from non-forest activities (e.g. fencing, making water-holes, trench, pipelines, check-posts, wireless communication, etc.) Penalties include a fine of up to Rs 500 per offence and imprisonment of up to six months.

#### **The 1992 Amendment in the Forest Act**

1. In 1992, some amendment was made in the Act which made provisions for allowing some non-forest activities in forests, without cutting trees or limited cutting with prior approval of the central government, These activities are the setting of transmission lines, seismic surveys, exploration, drilling and hydroelectric projects. The last activity involves large-scale destruction of forests, for which prior approval of the Centre is necessary.
2. Wildlife sanctuaries, national parks, etc., are totally prohibited for any exploration or survey under this Act without prior approval of the central government, even if no tree-felling is involved.
3. Cultivation of tea, coffee, spices, rubber and plants which are cash-crops, are included under non-forestry activity and not allowed in reserve forests.
4. Even cultivation of fruit-bearing trees, oil-yielding plants or plants of medicinal value in forest area need to be first approved by the central government. This is because newly introduced species in the forest area may cause an imbalance in the ecology of the forest. If the species to be planted is a native species, then no prior clearance is required.

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5. Tusser cultivation (a type of silk-yielding insect) in forest areas by tribals as a means of their livelihood is treated as a forestry activity as long as it does not involve some specific host tree like *Asan* or *Arjun*. This is done in order to discourage monoculture practices in the forests which are otherwise rich in biodiversity.
6. Plantation of mulberry for rearing silkworm is considered a non-forest activity. The reason is the same as described earlier.
7. Mining is a non-forestry activity and prior approval of the central government is mandatory. The Supreme Court in a case T.N. Godavarman Thirumulkpad Vs. Union of India (1997) directed all on-going mining activities to be ceased immediately in any forest area of India, if it has not obtained prior approval of the central government.
8. Removal of stones, *bajri*, boulder, etc., from riverbeds located within the forest area fall under non-forest activity.
9. Any proposal sent to the central government for non-forest activity must have a cost-benefit analysis and Environmental Impact Statement (EIS) of the proposed activity with reference to its ecological and socio-economic impacts.

Thus, the Forests (Conservation) Act has made ample provisions for conservation and protection of forests and preventing deforestation.

### Check Your Progress

5. Where do coniferous forests grow?
6. What are the major factors leading to depletion of forest resources?
7. What are the two main kinds of mine?

## 5.4 ENVIRONMENT ETHICS

Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment. It is rightly said, 'The environmental crisis is an outward manifestation of the crisis of mind and spirit.' It all depends on how we think and act. If we think 'Man is all powerful and the supreme creature on this earth and man is the master of nature and can harness it at his will', it reflects our human-centric thinking. On the other hand, if we think 'Nature has provided us with all the resources for leading a beautiful life and she nourishes us like a mother, we should respect her and nurture her', this is an earth-centric thinking.

The first view urges us to march ahead gloriously to conquer the nature and establish our supremacy over nature through technological innovations, economic growth and development without much botheration about the damage done to the planet earth. The second view urges us to live on this earth as a part of it, like any other creation of Nature and live sustainably. So, we can see that our acts will follow what we think. If we want to check the environmental crisis, we will have to transform our thinking and attitude. That in turn, would transform our deeds, leading to a better environment and better future.

These two world-views are discussed here in relation to environmental protection.

### **Anthropocentric Worldview**

This view guides most industrial societies. It puts human beings at the centre giving them the highest status. Man is considered to be the most capable for managing the planet earth. The guiding principles of this view are as follows:

1. Man is the planet's most important species and is in charge of the rest of the nature.
2. Earth has an unlimited supply of resources and it all belongs to us.
3. Economic growth is very good and the more the growth, the better it is, because it raises our quality of life and the potential for economic growth is unlimited.
4. A healthy environment depends upon a healthy economy.
5. The success of mankind depends upon how good managers we are for deriving benefits for us from the nature.

### **Ecocentric Worldview**

This is based on earth-wisdom. The basic beliefs are as follows:

1. Nature exists not for human beings alone, but for all the species.
2. Earth's resources are limited and they do not belong only to human beings.
3. Economic growth is good till it encourages earth-sustaining development and discourages earth-degrading development.
4. A healthy economy depends upon a healthy environment.
5. The success of mankind depends upon how best we can cooperate with the rest of the nature while trying to use the resources of nature for our benefit.

Environmental ethics can provide us the guidelines for putting our beliefs into action and help us in deciding what to do when faced with crucial situations. Some important ethical guidelines known as earth ethics or environmental ethics are as follows:

- One should love and honour the earth, since it nurtures life.
- One should keep each day sacred on earth and celebrate the turning of its seasons.
- One should not hold one above other living things and has no right to drive them to extinction.
- One should be grateful to the plants and animals which provides food.
- One should limit the number of offsprings because too many people will overburden the earth.
- One should not waste resources on destructive weapons.
- One should not run after gains at the cost of nature rather should strive to restore its damaged majesty.
- One should not conceal from others the effects that have been caused by one's actions on earth.

### **NOTES**

## NOTES

- One should not steal from future generations, their right to live in a clean and safe planet by impoverishing or polluting it.
- One should consume the material goods in moderate amounts so that all may share the earth's precious treasure of resources.

If we critically go through these ten commandments for earth ethics and reflect upon the same, we will find that various religions teach us the same things in one form or the other.

Our *Vedas* also have glorified each and every component of nature as gods or goddesses so that people have a feeling of reverence for them. Our religious and cultural rituals make us perform such actions that would help in the conservation of nature and natural resources. Even various festivals envisaged by Hinduism also prescribe the participation of humans in the celebrations through nature. (Nisarga Pooja is what we perform during celebrations of our festivals, e.g., Satyanarayana Pooja, Vatapournitma, Baishakhi, Ganesh Festival, Dusshera).

The concept of ahimsa in Buddhism and Jainism ensure the protection and conservation of all forms of life, thereby keeping the ecological balance of the earth intact. Our teachings on 'having fewer wants' ensure to put 'limits to growth', and thus, guide us to have an ecocentric lifestyle.

### Environmental Awareness

Public awareness about environment is at the stage of infancy. Of late, some awareness has taken place related to environmental degradation and pollution, but incomplete knowledge and ignorance about many aspects has often led to misconceptions.

Development has paved the path for rise in the levels or standards of living, but it has simultaneously led to serious environmental disasters. Issues related to environment have been often branded as antidevelopment. The wisdom lies in maintaining a balance between our needs and supplies so that the delicate ecological balance is not disrupted.

Some of the main reasons responsible for widespread environmental ignorance can be detailed as follows:

1. Our courses in science, technology and economics have so far failed to integrate the knowledge in environmental aspects as an essential component of the curriculum.
2. Our planners, decision-makers, politicians and administrators have not been trained so as to consider the environmental aspects associated with their plans.
3. In a zeal to go ahead with some ambitious development projects, quite often, there is a purposeful concealment of information about environmental aspects.
4. There is greater consideration of economic gains and issues related to eliminating poverty by providing employment that overshadows the basic environmental issues.

### Methods to Propagate Environmental Awareness

There is immense need for environmental awareness. It is to be created through formal and informal education to all sections of the society. Everyone needs to



understand it because ‘environment belongs to all’ and ‘every individual matters’ when it comes to conservation and protection of environment.

The various stages and methods that can be useful for raising environmental awareness in different sections of the society are given as follows:

1. **Among students through education:** Such education should be imparted to the students right from childhood. These studies are now being incorporated at all stages in schools and colleges as per the directives of the Supreme Court.
2. **Among the masses through mass-media:** Media can play an important role to educate the masses through articles, rallies, campaigns, street plays, TV serials, etc. This will appeal all age groups at the same time.
3. **Among the planners, decision-makers and leaders:** It is very important to give these classes of people necessary orientation and training through specially organized workshops and training programmes.

### **Role of Non-government Organizations (NGOs)**

Voluntary organizations can help by advising the government about some local environmental issues and at the same time interacting at the grass-root levels. They can act as effective and viable link between the two. They can act both as an action group or a pressure group. They can be very effective in organizing public movements for the protection of environment, through creating awareness.

The Chipko Movement for conservation of trees by Dasholi Gram Swarajya Mandal in Gopeshwar or the Narmada Bachao Andolan organized by Kalpvriksh are some of the instances where NGOs have played a landmark role in the society for the conservation of environment.

The Bombay Natural History Society (BNHS), the World Wide Fund for Nature-India (WWF-India), Kerala Sastra Sahitya Parishad, Center for Science and Environment (CSE) and many others are playing a significant role in creating environmental awareness through research as well as extension work. The recent report by CSE on more than permissible limits of pesticides in the cola drinks sensitized the people all over the country.

Before we all take up the task of environmental protection and conservation, we have to be environmentally educated and aware. It can therefore said ‘If you want to act green, first think green.’

#### **Check Your Progress**

8. Define environmental ethics.
9. How can media be used for environmental awareness?

## **5.5 ANSWERS TO ‘CHECK YOUR PROGRESS’**

1. Biodiversity is at three levels: genetic diversity, species diversity and ecosystem diversity.

## **NOTES**

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2. The habitat is divided into small and scattered patches, so that the complete loss of habitat can be put at bay. This phenomenon is known as habitat fragmentation.
3. The two types of methods of conservation of biodiversity are as follows:
  - a. Ex-situ
  - b. In situ
4. Animals and plant species introduced whether intentionally or accidentally from other countries, which are not otherwise found locally are termed exotic species.
5. Coniferous forests grow in the Himalayan mountain region, where the temperatures are low. These forests have tall trees with needle-like leaves and downward-sloping branches, so that the snow can slip off the branches.
6. Over use and irrational use, technological and industrial growth, population growth and increasing consumption levels are major factors causing depletion of forest resources.
7. The two main kinds of mine are underground mines and open-pit mines.
8. Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment.
9. Media can play an important role to educate the masses about environmental awareness through articles, rallies, campaigns, street plays, TV serials, etc. This will appeal all age groups at the same time.

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## 5.6 SUMMARY

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- Biodiversity functions in three levels: genetic biodiversity, species biodiversity, and ecosystem biodiversity.
- Genetic biodiversity means the variation of genes within a species. In a species, each variety has its own genes or genetic make-up. Diversity of genes within a species increases its ability to adapt to disease, pollution and other changes in environment.
- About 75 per cent of the world's population depends upon plants or plant extracts for medicines. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium.
- Ethical value means that we may or may not use a species, but knowing the fact that these species exists in nature gives us pleasure.
- The term 'Hot spots' was introduced by Myers (1988). There are twenty five such hot spots of biodiversity on a global level, out of which two are present in India, namely the Eastern Himalayas and the Western Ghats.
- Extinction or elimination of a species is a natural process of evolution. In the geologic period, earth has experienced mass extinctions. During evolution, species have died and have been replaced by others.
- Destruction and loss of natural habitat is the single largest cause of losing own biodiversity.

- Illegal trade of wildlife products by killing prohibited endangered animals, i.e., poaching is another threat to wildlife.
- Due to the tremendous importance of biodiversity it is considered an asset of a region or a nation. Due to its multiple advantages of commercial value, consumption value, medicinal value, social, cultural, religious and optional values, biodiversity needs to be conserved.
- There are two types of methods of conservation of biodiversity:
  - o Ex-situ
  - o In-situ
- A forest is a complex ecosystem which is predominantly composed of trees, shrubs and is usually a closed canopy. Forests are storehouses of a large variety of life forms such as plants, mammals, birds, insects and reptiles etc.
- Forests can be classified in different ways. The forest type depends upon the abiotic factors such as climate and soil characteristics of a region. Forests in India can be broadly divided into coniferous forests and broadleaved forests. They can also be classified according to the nature of their tree species—evergreen, deciduous, xerophytes or thorn trees, mangroves, etc.
- Over use and irrational use, technological and industrial growth, population growth and increasing consumption levels are major factors causing depletion of forest resources. Some other factors are mining, submergence due to big dams, shifting cultivation, use of forestlands for rehabilitation, agriculture, transport and tourism.
- Conservation, protection and overall management of forests are important. Entities involved in it are
  - o Government
  - o Community and community organizations
  - o Individuals and Private Bodies
- Forest Conservation Act deals with the conservation of forests and related aspects. Except for J & K, the Act is adopted all over India. The Act covers under it, all types of forests including reserved forests, protected forests or any forested land irrespective of its ownership. The Forests (Conservation) Act has made ample provisions for conservation and protection of forests and preventing deforestation.
- Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment. Environmental ethics can provide us the guidelines for putting our beliefs into action and help us in deciding what to do when faced with crucial situations.
- There is immense need for environmental awareness. It is to be created through formal and informal education to all sections of the society. Everyone needs to understand it because ‘environment belongs to all’ and ‘every individual matters’ when it comes to conservation and protection of environment.

## NOTES

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### 5.7 KEY TERMS

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- **Genetic biodiversity:** It refers to the variation of genes within a species. Diversity of genes within a species increases its ability to adapt to disease, pollution and other changes in environment.
- **Ecosystem Biodiversity:** This is the diversity of ecological complexity showing variations in ecological niches, trophic structure, food webs, nutrient cycling, etc.
- **Environmental ethics:** It refers to the issues, principles and guidelines relating to human interactions with their environment.

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### 5.8 SELF-ASSESSMENT QUESTIONS AND EXERCISES

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#### Short-Answer Questions

1. What are the major threats to biodiversity?
2. What are hot spots of biodiversity?
3. Briefly mention the ecological role of forests.
4. Write a short note on Chipko movement.
5. What are the salient features of Forest Conservation Act?
6. Write a short note on environmental ethics.
7. Briefly mention the role of NGOs in creating environmental awareness.

#### Long-Answer Questions

1. Discuss in detail in-situ and ex-situ conservation of biodiversity.
2. Explain the classification of forests.
3. Examine the role of entities involved in forest management.

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### 5.9 FURTHER READING

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