UG S1-01
(VAC)

FOUR YEAR BACHELOR'S DEGREE

(CBCS in Accordance with NEP 2020)

SEMESTER - I

ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

KRISHNA KANTA HANDIQUI STATE OPEN UNIVERSITY

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July, 2023

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ISBN: xxxxx xxxxxx xxxxxx

Printed and published by Registrar on behalf of the Krishna Kanta Handiqui State Open University.

Headquarters: Patgaon, Rani Gate, Guwahati - 781 017
City Campus: Resham Nagar, Khanapara, Guwahati - 781 022; www.kkhsou.in

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ACTIVITIES

Visit to an area to document environmental assets; river/forest/flora/fauna, etc.
Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.
Study of common plants, insects, birds and basic principles of identification.
Study of simple ecosystems-pond, river.

COURSE INTRODUCTION: ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

Krishna Kanta Handiqui State Open University offers Four Year Undergraduate Programme (CBCS; according to NEP-2020). Learners are required to study two courses as Value Added Course in the first two semesters along with other courses. Accordingly, the course of Environmental Studies and Disaster Management is offered for study in the First Semester.

Environmental and Disaster are the two most discussed terms in the world today. All living and non-living things we see around us contribute a part to our environment. But our invironment is subjected to ruthless destruction leading to many problems and even to disasters. Disaster is an event of occurrence due to natural as well as human-induced factors. Generally, it happens without any warning or with a warning of a very short period of time. All disasters cannot be prevented, but if with adequate planning and prior preparations, the impact of disasters can be minimized to a large extent. Therefore, in order to resolve these problems, conservation of the environment is of utmost importance. It is also necessary to study disaster management. On the other hand, environment conservation and disaster management are possible only if the general people are made aware about them. Therefore, the university has included a course on "Environmental Studies and Disaster Management" in its graduate programme. The course consists seven units for the benefit of discussion and some activities.

Unit 1	:	Concept of Environmental Studies
Unit 2	:	Natural Resources
Unit 3	:	Ecosystem
Unit 4	:	Biodiversity and Its Conservation
Unit 5	:	Environmental Pollution
Unit 6	:	Concept of Disaster
Unit 7	:	Disaster Management

In unit 1, you will read about the nature and scope of environmental studies, its definition, importance, objectives, multidisciplinary character and the environmental principles. Besides, you will also come to know about the importance of public awareness about environmental conservation. In unit 2, you will read about natural resources and how their proper use can be beneficial for the development of mankind. Unit 3 will acquaint you with the ecosystem and the various topics associated with it, like food chain, food web, energy flow, ecological pyramid etc. Unit 4 includes biodiversity and various factors associated with its conservation. In unit 5, you will read about the causes of environmental pollution, its sources and its effects. Units 6 and 7 will give you an idea about disaster, its types and how to combat it, i.e. disaster management.

While going through a unit, you will notice some boxes, containing such information as would help you to understand some of the difficult, unfamiliar terms. You will find an item called "ACTIVITY' where you will apply your knowledge and thoughts in some questions pertaining to the relevant topic. Again, we have included some relevant concepts in "LET US KNOW" along with the text. And, at the end of each seection, you will get "CHECK YOUR PROGRESS" questions. These have been designed to self-check your progress of study. It will be better if you solve the problems put in these boxes immediately after you go through the sections of the units and then match your answers with "ANSWERS TO CHECK YOUR PROGRESS" given at the end of each unit.

UNIT 1 : CONCEPT OF ENVIRONMENTAL STUDIES

UNIT STRUCTURE

1.1 Learning Objectives

1.2 Introduction

1.3 Definition of Environmental studies and its scope

1.4 Environmental studies and its multi disciplinary nature

1.5 Rules and Regulations of Environmental studies and public awareness.

1.6 Let us sum up

1.7 Further reading

1.8 Answers to check your progress

1.9 Possible questions

1.1 LEARNING OBJECTIVES

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

- define environmental study
- understand the nature and scope of environmental study
- know the significance and rules of conservation of environment
- find out the steps for preservation of environment.

1.2 INTRODUCTION

In recent times, environmental studies have gained importance all over the world. It is essential that everybody should know about the basic issues and concepts included in environmental studies. Since all living beings e.g. plants and animals, and the surrounding non-living objects, are parts of the environment, so environmental studies include all of them. It is therefore necessary for everyone to know about the environment, its significance for our survival and the need for preservation of the environment.

Constant increase in population and also increase in human activities alongwith the rapid industrialisation and the use of machines and transport have their impact on nature, which has caused rapid changes in the environment leading to environmental pollutions. For all these reasons preservation of environment is essential. Creation of public consiousness/ awareness has become the call of the hour.

1.3 NATURE AND SCOPE OF ENVIRONMENTAL STUDIES

Records show that people were conscious about environment in the past. We can find traces of conservation of environment in Indian culture during the Vedic age. According to different religious practices and customs, animals and plants were worshipped. The creation of different animals and plants in different environment was known to people long time ago. Scientific studies were carried out on the mutual impact of living beings and environment and a new study was started in the year 1869 for the first time, which came to be known as environmental studies.

Because of the pioneering efforts of some people the concept of conservation of environment was gradually gaining importance.

A healthy environment presuppous the the existence of the following elements:

- Pure air
- Plenty of clean water
- Adequate/ Plenty of place for growth and development
- Abiotic salt and strength needed for the growth and development of the body.

In reality all human beings and animals are dependent on plants. Again plants are dependent on various micro organisms, insects, birds for their living. Therefore, environment is made up of

- all living beings and non-living objects that are components of environment
- All kinds of living beings are essential to sustain environment.

- All living beings are interdependant. Because of these reasons, the concern for conservation of environment is growing all over the world.

For the first time Charles Darwin in his book *Origin of Species* in 1859 scientifically established the relationship between living beings and their habitats. In fact, Ralph Emerson, before Darwin, in 1840 warned that business-activity would destroy environment. Rachel Carson, an American lady wrote in an article about the use of insecticide/pesticide and also wrote a book *Silent Spring* which became a pioneering work in modern environmental revolution. India was also not lagging behind. Infact noted ***Ornithologist*** Salim Ali's *Book of Indian Birds* and his autobiography *Fall of a Sparrow* are regarded as the path-breakers in the study of environment. Sundarlal Bahuguna who is associated with *Chipku Agitation* and Medha Patkar who stood for the Narmada Bachao agitation have championed the cause of the protection of environment. It can be mentioned here that M.C. Mehta fought for the protection and preservation of the Taj Mahal. Voices have been raised for cleaning the water of the Ganga and also for the inclusion of environmental studies in the curriculum of schools and colleges. Besides, cases are also lodged in the courts of justice for the protection of environment for the public interest.



Ornithologist : One who studies birds

The scope of environmental studies is very vast. Since several areas and numerous elements have been covered in this subject, its scope has been gradually increasing.

The following are the contents of the couse on environmental studies:

- **Natural Resources :** their preservation and conservation and their management.
- Eco-system and Bio-diversity.
- Environmental pollution and control
- Social problems connected with environment and development
- Population and environment

The treasures which are given by nature for our use are called the natural resources. Nature endows us with all the required materials which fulfil our essential needs and which are necessary for us to enjoy a happy life. But the supply of these natural treasures is very much limited. On the

other hand, population explosion and our constant desire to live a luxurious life have led us to use these naturals resourse indiscriminately. As a result, many natural resources gifted by nature have gradually become scarce. So, how to conserve and manage these resources in a balanced manner is the subject of discussion in environmental studies.

Plants and other living beings on this earth have undergone various changes and stages of evolution before reaching the present stage. Nature has created an intimate relationship between plants and living beings. In short, this is known as eco-system. Earthly elements play a significant role in creating living beings and plants.

From the combination of biotic and abiotic elements various species are created in the eco-system. Diversity of plants, living beings, organisms and all other diverse species present in the eco system taken together are called bio-diversity. Bio-diversity and Eco-system are another area of discussion in this unit. The presence in the air, soil or water of a substance with harmful effects is called pollution. Changes in environmental conditions affect natural life. Sometimes even the identity of living species is endangered.Pollution is due to some natural and man made causes. Environmental studies study the problem of pollution, how it is caused, what are its effects and how it can be controlled.

Human beings through their intelligence have utilized natural resources. As opposed to other living beings, human beings have been trying to exploit natural resources through science and technology and due to this exploitation, nature has been affected. These man made problems are also discussed in Environmental studies. Population explosion is another grave problem. Rapid advancement of science and technology has significantly reduced the human mortality rates, while human birth rate has also increased in some countries, including India. The continuous rise in population has resulted in large scale utilization of the natural resources leading to a pressure in the environment which is undergoing rapid changes. Population explosion and its effect on nature is another matter of discussion.

- **Definition of Environmental Studies:** Environmental study is the methodical and scientific study of the environment and how socio-economic and other factors affect it. The elements coustituting the environment are divided into two – living beings and non living matter. This relationship between living beings and non living matter and the impact of the change of these two elements over other elements are a basic concern of Environmental studies.
- **Objective of Environmental Studies:** The main objective of environmental studies is to discuss what environment is and what is the relationship between the different elements of the environment.

  Environmental studies discuss the relationship among various living and non-living things, as well as the relationship among the various species. Its influence on human beings, the interdependence between man and other species and how human activities influence them are some of the issues to be discussed within the scope of Environmental Studies.

1.4 MULTIDISCIPLINARY PERSPECTIVES OF ENVIRONMENTAL STUDIES

This is now clear from the definition of environmental studies that this is a unique brand of study. There is a need to understand the problems of environment and their solution and for this a general conception of science, commerce, arts, technology, law, medical science, computer etc. is essential.

Environmental study is called a multidisciplinary subject. In order to protect the world from destruction, the relationship among the different elements is necessary. Besides, it is also essential to know as to how to protect the envioronment. Environmental studies include all such subjects. That is why environmental studies can be called a multi disciplinary subject.



CHECK YOUR PROGRESS

Q 1. Do you think 'Environmental Studies' is a subject matter of science only?

.....

Q 2. What kind of impact is made by the increase in population on environment.?

.....

.....



ACTIVITY – 1.1

1) Observe the elements of envioroment that influence your day to day activities?

.....

.....

2) Prepare a list of the ways by which you can control pollution?

.....

.....

.....

1.5 RULES AND REGULATIONS OF ENVIRONMENTAL STUDIES AND PUBLIC AWARENESS

Problems arising out of the several conflicting processes among the environmental elements and human beings alongwith the instructions of environmental conservation are included in an environmental study. Infact, the environmental problems are caused by human activities. All the elements gifted by nature are considered essential for human survival. But when natural resources are hapazadly used by man environmental problems are created. The humancentric thoughts consider nature's gifts as man's exclusive domain. On the otherhand, another school of thought, which is nature centric, considers nature as mother and lays emphasis on the conservation of nature. This kind of thought is beneficial to nature as well

as to other living beings and this in a way helps to create a positive natural environment.

On the basis of these two contradictory schools of thoughts, – human centric and nature centric – some guidelines/principles are adopted to maintain sustainable environment, They are –

- Nature has given us all the necessary requirements for living. Therefore, it is our duty to love and care nature.
- We should consider each day a sacred day because on each day nature changes and this change of nature brings to us the advent of a new season.
- Considering man to be superior to other beings, man has no right to push other beings towards destruction.
- We should always be grateful to plants and other living beings because they provide us the necessary food for the sustainability of our life .
- Man should control the rapid rise in population because it causes an incrasing burden for nature.
- We should not waste the rare resources for destructive purpous like creating deadly weapons.
- Instead of exploiting nature for use in our self interest, we should try to protect the loss and damage caused to nature by excessive human interference.
- It is nothing but a futile attempt to escape from the complaint that we are not guilty for the deeds of destroying natural resources.
- Our future generation should not suffer because of our exploitation of nature and that we should be conscious of this fact.
- Limited resources of nature should be enjoyed equally by all and they should be used in a limited or economical way.
- **Public Awareness:** Conservation of environment is related to public co-operation and if public cooperation is missing then nither any government nor any public organization can be successful in environmental development. Public co-operation is dependent on public awareness. It is not possible to solve environmental problems without public co-operation and their knowledge relating to environment. For

instance, in the present context, the use of polythene and lack of knowledge as to how these polythenes create pollution and what are its impacts on society are some of the issues which demand general public altention. Only legal actions cannot solve these problems.

Instead of doing things that harm nature, man should feel the necessity to protect and conserve nature and to spread knowledge through environmental studies to solve the environmental problems.

Therefore, awareness for the protection of environment should be the main motto here of Environmental Studies.



CHECK YOUR PROGRESS

Q 3. Why should we protect the bio diversity in nature? Give reasons.

.....

.....

Q 4. Do you think public awareness is necessary for the protection of environment? How can this awareness be created?

.....



ACTIVITY –1.2

1) Prepare a list of plants, animals and insects that you can find near your home and mention why they are necessary for us?

.....

.....

.....

2) Share with your friends your concern for the protection of environment and discuss the ways to create public awareness about environmental protection.

.....

.....

.....



1.6 LET US SUM UP

- People have been conscious about environment since time immemorial.
- Scientific studies have been carried out on the impact of the living beings on environment and this kind of study was started in the year 1869. Earnest Hackal for the first time scientifically explained environmental studies.
- The importance of environmental studies cannot be denied and this subject is essential for law, medicine, science, commerce etc.
- The influence of environment can be seen in all aspects of our life and work and therefore it is essential to have some knowledge about this subject. Our education is incomplete without this knowledge.
- More pollution will create more danger to the lives of the living beings. Therefore it is necessary for all living beings to conserve environment in order to sustain.
- It is not the sole duty of the government to protect environment. In order to protect nature, all human beings should come together and act towards it. Therefore, it is important to create awareness among the general public for a clean and healthy environment by protecting its resources.



1.7 FURTHER READING

1) Asthana, D. K. & Meera A. (2012) *A Textbook of Environmental Studies*. New Delhi: S. Chand and Company Ltd.
2) Bharucha, E. (2004). *A Textbook of Environmental Studies.* New Delhi: UGC.
3) Kaushik, A. & Kaushik, C. P.(2006) *Perspectives in Environmental Studies.* India: New Age Publications (Academic).



1.8 ANSWERS TO CHECK YOUR PROGESS

Ans to Q No 1: Cannot think.

Ans to Q No 2: Due to the rise in population, nature is exploited to meet the demands of the growing population and on account of the pressure of such exploitation the environment is polluted.

Ans to Q No 3: Nature has given us all the necessary requirements and therefore it is our duty to love and nurture nature.

Ans to Q No 4: Yes



1.9 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. What do you mean by Environmental studies?

Q 2. How can pollution be controlled through environmental studies?

SHORT ANSWER QUESTIONS

Q 1. Explain the importance of rules and principles of Environmental studies.

Q 2. Explain the importance of Environmental studies in the present context?

LONG ANSWER QUESTIONS

Q 1. Environmental studies being a multidisciplinary subject, mention the other subjects which have relation with it. Explain.

Q 2. What is the role of Environmental studies in the conservation of bio-diversity?

*** **** ***

UNIT 2: NATURAL RESOURCES

UNIT STRUCTURE

2.1 Learning Objectives
2.2 Introduction
2.3 Natural Resources
2.4 Types of Natural Resources
2.5 Forest Resources
2.6 Water Resources
2.7 Mineral Resources
2.8 Food Resources
2.9 Energy Resources
2.10 Land Resources
2.11 Conservation of natural resources
2.12 Sustainable development
2.13 Let us sum up
2.14 Further Reading
2.15 Answers to check your progress
2.16 Possible questions

2.1 LEARNING OBJECTIVES

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

- get some idea about what is meant by natural resources
- discuss the different types of natural resources
- distinguish between renewable and non-renewable sources of energy
- reflect on the problems of deforestation
- acquire knowledge about the proper use of water resources
- realize the dangers of over exploitation of mineral resources
- get an idea about food resources and food-chain equilibrium
- discuss energy resources and their use for the welfare of human beings

- discuss how land resources can be properly utilized for agriculture
- discuss why natural resources should be conserved
- describe sustainable development and its necessity

2.2 INTRODUCTION

The world we live in is full of different resources. These resources are naturally created or produced. The various requirements of man can be fulfilled through these natural resources. Some of these resources are exhaustible and some are inexhaustible. Of the exhaustible resources, some are renewable and some non-renewable. Water resources, air, rainfall, solar energy etc are inexhaustible. Man cannot exhaust these through continuous use although he can degrade them or make them scarce through his harmful activities. Water, wood, grasslands, forests, wild animals, soil and biotic matter etc are recreated by nature. On the other hand, fossil fuels such as coal, petroleum, natural gas are never reproduced. So these are called non-renewable resources.

The continuation of mankind and the human civilization depends upon proper use of natural resources. Therefore, it is essential to have a holistic knowledge about the suitable use of natural resources for the development of man. This unit deals in detail with some of the above mentioned issues.

2.3 NATURAL RESOURCES

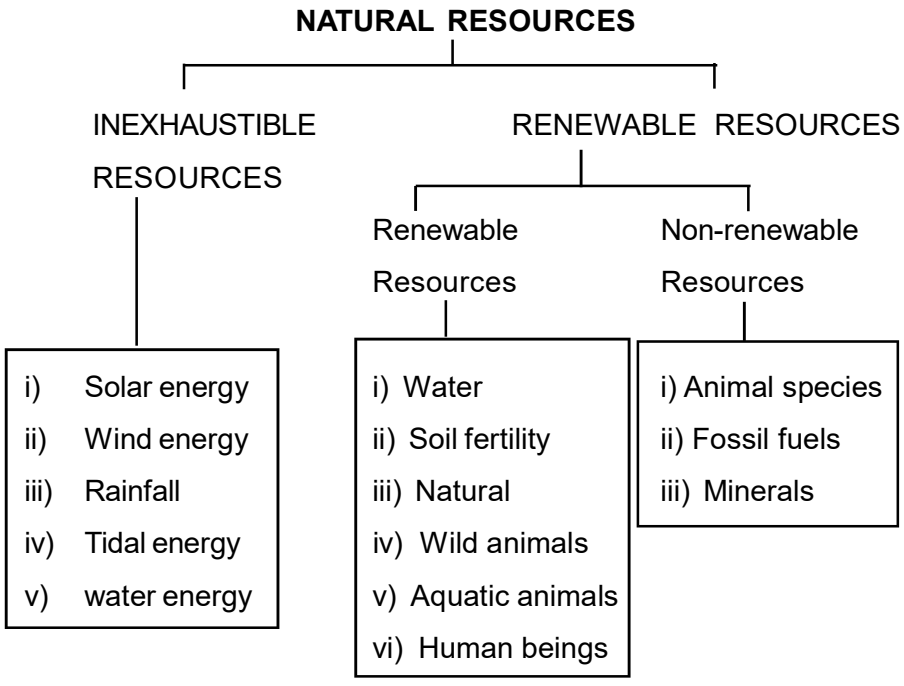
Resources are the storehouse of supply. The necessary requirements of men which can be fulfilled from materials derived from nature are called natural resources. The basic needs of men such as food, clothes and shelter can be met from natural resources.

2.4 TYPES OF NATURAL RESOURCES

Depending on their availability, natural resources can be divided into two types— Inexhaustible resources and Exhaustible resources

- **Inexhaustible Resources :** These resources are in great abundance. Men cannot exhaust them even through their continuous use. Air, sand and solar radiation are some examples of inexhaustible sources of energy.
- **Exhaustible Resources :** These are of two types –
  - Renewable resources
  - Non-renewable resources.
  - *Renewable resources* : As these resources are relentlessly used by men, nature keeps renewing these resources. For example, – water, wood, natural grasslands, soil and bio-elements, forest, wild animals etc. The resources are renewed as a result of sudden relocation, rebirth, change and reformation within a certain period of time.
  - *Non-renewable resources:* These resources do not reappear once it is exhausted and nature also does not reproduce them. For example - fossil fuels (coal, petrol), minerals like copper, iron, animal species, etc.

Figure 2.1: Division of Natural Resources



2.5 FOREST RESOURCES

The biological group which consists of trees, shrubs, vines and other plants and which forms a thick canopy over the earth's surface, sometimes preventing light from penetrating below, is called forests.

40% of the earth's surface is covered by forests. The open and closed forests constitute 1/3rd of the earth's land mass. India is rich in flora and fauna, and most of these species are to be found in forests. There are different kinds of trees in forests. The forest resources of the world shown in the table below.

Table 2.1 : Change in forested land 1990-2000 by region

Region	total land area (million ha)	total forest 1990 (million ha)	total forest 2000 (million ha)	% of land forested in 2000	change 1990-2000 (million ha)	% change per year
Africa	2 963.3	702.5	649.9	21.9	-52.6	-0.7
Asia and the Pacific	3 463.2	734.0	726.3	21.0	-7.7	-0.1
Europe	2 359.4	1 042.0	1 051.3	44.6	9.3	0.1
Latin America and the Caribbean	2 017.8	1 011.0	964.4	47.8	-46.7	-0.5
North America	1 838.0	466.7	470.1	25.6	3.9	0.1
West Asia	372.4	3.6	3.7	1.0	0.0	0.0
world	**13 014.1**	**3 960.0**	**3 866.1**	**29.7**	**-93.9**	**-0.24**

Source: compiled from FAO 2001b Note: numbers may not add due to rounding

- **Uses of Forest Resources:** The main uses of forests are –
  - *Food :* The tribal people acquire their staple food – like roots, shoots, leaves, fruits – from the forests.
  - *Fuel :* The wood required for cooking and protection from cold are derived from forests. Nearly 1500 million people around the world depend upon forests for their livelihood. Almost 1000 million tons of wood are used as fuel around the world.
  - *Wood :* The wood required to build houses, bridges, different kinds of furniture, doors and windows, berths in trains, boats, ships, sports goods, agricultural equipment etc are collected from forests.
  - *Paper :* Bamboo pulp is used to produce different types of paper like newsprint, packing paper, papers for writing etc.

- *Necessary materials :* The flora and fauna of the forest provide the raw materials for different kinds of essential goods. e.g. different kinds of oil (pure sandal) for the production of camphor, soaps and cosmetics, gum and soap based materials like shikakai etc for industrial use; worms and insects needed to produce lac, honey, wax, silk etc; horns and hides; Ivory etc. The raw materials for the production of different medicines, spices, poisonous substances, insecticides etc are derived from forests.
- *Protection of the environment :* Forest cools the climate of the environment and controls the rainfall. The moist climate of summer is conducive for the survival of plants.
- *Oxygen production :* When plants produce food through photosynthesis, they also at the same time release the necessary oxygen for animals to breathe.
- *Shelter :* The trees in the forests provide shelter and support to different species like insects, reptiles, birds, mammals, moss and lichen, creepers etc.
- *Soil conservation :* Forests prevent soil erosion. The reasons are –
  - Roots hold the elements of the soil.
  - The fallen leaves reduce the surface runoff.
  - The trees also help to reduce the speed of winds.
- *Soil fertility :* The decomposition of fallen leaves creates a layer of humus and this increases soil fertility
- *Control of water-cycle :* The layer of humus in the forests keeps the currents of rivers, streams, lakes etc. under control. It acts like a giant sponge and absorbs a lot of water, and releases it slowly
- *Reduction of pollution :* The carbon dioxide gas used during photosynthesis reduces air pollution.
- *Necessary for beautification :* The natural beauty of forests has recreational and aesthetic value.

- **Over Exploitation:** The forest area is dwindling as a result of man's increasing pressure on it. The reasons for this are :

- Over population of men and animals
- The demand for immense quantities wood for fire and industries. (The value of the international wood industry is 40 million US dollars yearly.)
- Requirements of food, clothes and shelter.
- Requirements of land for agriculture and grazing.
- Mining, construction of roads, and river valley construction projects.

- **Deforestation:** According to a survey, the forests of India dwindled from 7000 million hectares in 1900 to 2890 million hectares in 1975. This further came down to 2300 million hectares in 2000. Tropical rainforests are the most productive regions of the world. In 1975, this region saw a decrease from 1600 million hectares to 938 million hectares.
  - *The main causes of deforestation are:*
    - Forests are cleared in order to meet the food requirements of the increasing population in the developing countries of the world.
    - Forests are exploited to procure the wood necessary for establishing industries, construction of roads and buildings.
    - Forest fires also destroy trees.
    - Some insects and pests eat the leaves, spread diseases, and destroy trees.
    - Grazing animals and those that live underground feed upon tender, unripe plants.
    - Forests are also reduced as a result of jhum cultivation in different states which consume 5 lakh hectares of the forest area yearly.
  - *The results of deforestation are :*
    - There is always a possibility of loss of land due to deforestation
    - Possibility of floods and drought.
    - Loss of animals and plants.
    - Shortage of wood and energy sources.
    - Negative effects on climate and less rainfall leading to increase in atmospheric temperature.



CHECK YOUR PROGRESS

Q 1. What are the exhaustible and inexhaustible resources?

.....

Q 2. What are the effects of deforestation?

.....

.....

2.6 WATER RESOURCES

Water is a renewable source. Like air, water is also extremely essential for the various physical, biological and chemical processes of plants and animals. Water is always necessary for human beings to live, and also for their economic development. Three-fourths of the earth's surface are covered with water. Water also constitutes 60-70% of man's total weight.

- **Types of Water:** Water is generally found in two states – Groundwater and surface water,
  - *Underground water :* Ground water constitutes 9.86% of the total freshwater. ***Aquifer*** is a sediment or rock layer which is highly permeable. This layer contains water and transmits water. Sand and gravel are good examples of aquifer. Aquifer is of two types – unconfined aquifer and confined aquifer.
    - Unconfined aquifer : In unconfined aquifer permeable materials are laid and it gets rechanged by rainfall and seasonal melt waterthat seeps down.
    - Confined aquifer : Confined aquifers are pereable aquifers like sand that lie between two impermeable layers of rock and sediment.

      If withdrawal of ground water is more than the recharged water, sediments get compacted which leads to ground subsidence. Following situations may occur in ground subsidence –



Aquifer : a body of rock that holds water or through which water flows

(a) Land surface may sink

(b) Damage of structure in building

(c) Pipes may rupture

(d) Reverse flow may occure in sewers and canals

(e) Tidal flood may occur

- *Surface water :* Surface water is found in various states like streams, rivers, lakes, ponds, wetlands, artificial water reservoirs, etc. When rainwater and water from melting snow do not penetrate below the earth's surface, they flow as surface runoff or accumulate in the depression on the surface of the earth, and form the surface water.

  Surface water is used for different purposes. Some of them are– (a) Public water supply, (b) Irrigation, (c) Industrial use, (d) water transport.

- **Floods :** In 90% of the regions in our country rainfall occurs in certain months of the year (generally from June to September). Rainfall is not equal throughout the year. During the monsoons, due to excessive rain, the rivers overflow and create floods. There are many reasons because of which floods occur. Those which are worth mentioning are –
  - Excessive rainfal
  - Drainage cougesion
  - Deforestation
  - Excessive animal grazing
  - Urbanization and Industrialization
  - Global warming.

- **Drought :** When evaporation of water is more than the amount of rainfall, then a drought situation occurs. The scarcity of water leads to drought. If rainfall is 75% less than the normal rainfall, drought occurs. The main causes of drought are as follows :
  - Less rainfall
  - Increase of population in drought areas and decrease in soil fertility

- Deforestation, excessive animal grazings, mining etc. which create a desert like situation.
- Excessive drought reduces the water levels in streams and other water bodies.

The following steps need to be taken in order to control drought situation:

- Growing mixed crops
- Social forestry and water land development
- Stop plantation of eucalyptus and similar kinds of trees – as these species of trees lower the surface water levels.

- **Water disputes:** Water is very essential for plants and animals to survive. The unequal distribution of water in the countries and states leads to disputes. Some of the disputes which have occurred because of water are:
  - *Middle-East water dispute :*
    - There are continuous raging disputes among Jordan, Syria, Israel, etc regarding the water distribution of the Jordan river.
    - The Middle-Eastern countries share the water of the Jordan, Tigris- Euphrates and Nile rivers. The excess water used by Ethiopia and Sudan has led to scarcity in the desert regions of Egypt. If all the current projects of 22 dams for generation of hydro-electricity starts, then Turkey will reduce the amount of water flow into countries like Syria and Iraq. Turkey is trying to acquire power using an immense volume of water resources
  - *Indus River Treaty :* According to the Indus River Treaty of 1960, Indus, Jhelum and Chenab were included within Pakistan. India gained acquisition over Shatadru, Ravi and Bipasha rivers. The treaty propounds that India cannot practically use the river water included within Pakistan. As a result of the construction of Chakkur dam over the Jhelum (1932), the Ghulam Mohammed Dam in Kotry (1958) and the Tarbela and Chasma dams over the Jhelum river, the Indus river peninsula has faced water scarcity.
  - *Shatadru-Yamuna River Canal Dispute :* On 15 January 2002, the Supreme Court of India ordered the Punjab Government to complete

the Shatadru-Yamuna river canal project within one year, in order to divide the waters of the Ravi-Bipasha rivers and for the Shatadru-Yamuna river canal. However, this dispute has led to the scarcity of water in Haryana. The request from the Punjab Govt. to the Supreme Court to reconsider its decision has fallen on deaf ears.

- *The proposed dam over the Brahmaputra river by the Chinese Govt. :* The recent reports regarding this problem have contended that if dams are constructed in the upper reaches of the Brahmaputra, then it will lead to reduction in the water level of the Brahmaputra in its lower reaches like Assam. Moreover, it will also create problems for the people of Assam as well as the entire North-Eastern region.

- **Dams:** If proper design, safe locations and possible impacts on environment and society in the downstream areas are considered during the planning, construction and operation stage of the projects, then river dams may provide the following advantages.
  - *Advantages :*
    - Reduce shortage of energy through hydro-electricity generation.
    - Employment for the local people.
    - Economic development and progress.
    - Control of floods and drought.
    - Irrigation system in the plains.
    - Supply of drinking water, improvements in water transport, fishery.
  - *But river dams have also the following disadvantages:*
    - Destruction of forests, plants and animals
    - Negative impact on the local people – their livelihood and security.
    - Fundamental changes in the climate
    - Spread of diseases like malaria etc.
    - Formation of water puddles,
    - Possibility of earthquakes due to the influence of water reservoirs.
    - Increase in salt-content due to excessive irrigation.

- Decrease in soil fertility due to holding back of nutrients in the down reservior.



CHECK YOUR PROGRESS

Q 3. How low should be the amount of rainfall for a drought situation to occur?

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Q 4. Mention four problems of big dams.

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2.7 MINERAL RESOURCES

The discovery, extraction, purification and use of mineral resources is a great means of support for developing countries, including India. These minerals normally have characteristic chemical and physical properties.

- **Types of Mineral Resources:** Mineral resources are of two types –
  - *Non metallic* e.g. Diamonds, graphite, quartz.
  - *Metallic*, e.g. Bauxite, pyrita etc.
- **Extraction and Use of Mineral Resources:** Minerals are found in ores. The ores are extracted from the earth's crust, and after purifying and refining them through different processes, the minerals become suitable for use, Minerals are used for different purposes. Examples–
  - For industrial purposes and development of mrchanical systems.
  - Used in coal, lignite and uranium energy production
  - Making of weapons and ammunition
  - For cable, telephone and other communication systems
  - Preparing medicines
  - For making gold, silver and diamond jewellery
  - Use of silver in preparing photographic plates, electronics and jewellery.
  - For use as fertilizer and insecticide in agriculture.

- **Environmental Impact of Mineral Extraction and Use :** After mining and extraction, when minerals are disposed of, it leads to pollution of air, water and soil. Some examples of the ill-effects of mining are as follows :
  - Because of the uranium mining field in Jaduguda, the people of Jharkhand and nearby areas are in danger of being exposed to nuclear radiation.
  - Because of fire outbursts in the coal mines, the people around the Jharia coalmine region have been forced to flee to other places.
  - In Karnataka's Kudremukh region, iron ore mining has led to pollution of rivers.
  - Because of open-cast mining in the coal mines of upper Assam, the environment of the surrounding areas has been polluted to a great extent. The sulphur content in ground water has increased.

    There are two types of mining –

    (a) Surface mining

    (b) Underground mining
- **Harmful effects of mining :** The harmful environmental effects of mining are as follows –
  - Destruction of plants
  - Geographical changes
  - Depression of the earth surface
  - Pollution of ground water
  - Air pollution.
  - Surface water pollution
  - Affecting the health of miners.

  The harmful effects of mining are to be controlled in order to keep the environment clean. Mining should always be conducted keeping in view the health of the environment. Microbial backing process is used when extracting minerals from low quality ores. Trees should be planted in the regions where mining takes place. The flow of toxic substances after refining the ores should be controlled.

There are gold mines in Karnataka and Kerala. When the minerals available for the usage of human beings are measured against the timeline, it is called “the lifetime of earth’s minerals”.

Table 2.2 : Essential minerals and their lifetime

Minerals	Lifetime
Coal, Iron, Chromium	2500-2800 AD
Aluminum, Cobalt, Manganese	2100-2200 AD
Crude oil, natural gas, Uranium, lead, Zinc, gold, Silver, tin	2000-2100 AD



CHECK YOUR PROGRESS

Q 5. What are the different types of mineral resources?

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Q 6. Mention some of the environmental impacts of mining.

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2.8 FOOD RESOURCES

Food is a basic necessity for living beings. Only green plants can produce their own food. Food contains carbohydrates, proteins, fats, bio-acids, vitamins, mineral salts etc.

According to the Food and Agricultural Organization (FAO), the minimum calorie intake for a person is 2500 calories per day, Malnutritioned people get only 80-90% of this amount. People suffering from severe malnutrition get even less than 80% of the daily calorie intake.

Deficiency of the required nutrition is called malnutrition. Lack of adequate quality and quantity of the requisite food leads to malnutrition. World Health Organization is an international organization.

- **World Food Problem:** Even though food production in the developing countries is increasing, it is not yet proportionate to the increasing

population. The result is that some people do not get a balanced diet and suffer from lack of nutrition. Lack of nutrition creates physical disorder in human beings. This is known as nutritional deficiency disease. 300 million people in Indian suffer from malnutrition. There is a direct relation between population explosion and food problem.

Some harmful effects of malnutrition are as follows :

- Increase in child mortality
- Increase in mother mortality
- Retarded brain development
- Low academic performance

In the World Food Summit held in 1996, a resolution was taken to the effect that by 2015, the percentage of people suffering from malnutrition will be reduced by half. Poverty is the main cause of malnutrition. The parents of poor families cannot provide the requisite food to their children.

- **Agricultural Methods:** In the prehistoric age, people procured the necessary food by hunting wild animals and eating edible plants. They made different stone implements using great skill in order to hunt animals. They led a nomadic life as they were continuously in search of food. They spent most of their time in hunting animals and procuring food. Agriculture means cultivating and growing crops in a piece of land. As time passed, the prehistoric people learnt to produce their own food, and consequently they changed from “food gatherers” to “food producers”. It has been found that agriculture was first started in Thailand. Excavation works in Thailand have revealed the remains of rice and soybean cultivation. These are said to be 10000 years old.

  Traditional agricultural methods have three harmful effects:- Deforestation, Soil erosion, Decrease in nutrition

  - *Effects of modern agricultural methods:*The Green Revolution is a success story of Indian agriculture. Its sucess was due to the following reasons :
    - Use of more productive seeds
    - Use of skilled machinery

- Use of fertilizers, pesticides and nutritional aids for irrigation.

But the use of modern agricultural methods has also created some problems. They are :

- When highly productive seeds are sown equally in all the plots of land, the chances of the spread of diseases in them are relatively high.
- Two problems arise when chemical fertilizers are used –
  (a) Blue Baby syndrome as a result of nitrate pollution.
  (b) Eutrophication : If huge amounts of nitrate from the fertilizers are dissolved in water, it creates a thick layer of algae. These algae use a lot of liquefied oxygen in the water. Consequently, the living beings in the water get less oxygen and suffer untimely death. The decreased productivity in the ponds and lakes is due to increasing of algae and weeds called eutrophication. Eutrophication has resulted in the decrease of the area of Srinagar's Dal Lake from 15 km^2 to 12 km^2.
- Some of the problems arise due to the use of pesticides. For example, the excessive use of DDT can create certain pesticide resistant insects. Besides, the use of pesticide beyond the permissible limit may cause death to lives.
- Lack of proper drainage system and accumulation of water due to excessive irrigation.
- Increase in soil salinity when saline compounds like sodium chloride, sodium sulphate, calcium chloride etc. are deposited in the soil. When saline water is used for irrigation, the effect is doubled. The saline soil decreases crop productivity. Different methods can be used to reduce soil salinity –
  (a) Use of better quality water
  (b) Spreading the inland network through open canals.

  The Central Soil Saline Research Institute in Kerala has succeeded in making a saline village called Jarika Biran into a salt free one. This has made the village richer in crop production.

Excessive animal grazing has also adversely affected the soil. For example, the quality of soil is degraded, useful plants become extinct and various harmful plants like parthenium, lantina and jenthiam and other cacti prosper.



CHECK YOUR PROGRESS

Q 7. What are the different types of food?

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Q 8. What methods can be used to make the soil less saline?

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2.9 ENERGY RESOURCES

The capacity to do work is called energy. The economic development of a country depends on the per capita energy use. Nobody can seize energy; it can only be used for work. Energy is never destroyed; rather it transforms from one state to another.

There are different types of energy –

- Solar energy
- Hydro power
- Nuclear energy
- Wind energy
- Bio mass energy

The main sources of energy like the physical energy of men and animals, wind energy, the oils produced from wood and forest reserves etc. do not create pollution. But after the industrial revolution, industries extracted energy from the sources like coal, crude oil, natural gas etc. When these products are burnt it creates pollution of the environment. In trade and industry, 95% of the energy comes from fossil fuels. But in the near future, fossil fuels will face the danger of extinction. The total national production in case of countries like America, Switzerland, Norway etc. is

quite high. In these developed countries, the per capita use of energy is 250000 kg calories. In that case, in a developing country like India, the per capita use of energy is 10000 kg. calories.

- **Sources of Energy:** There are two sources of energy :Renewable source and Non-renewable sources .
  - *Renewable source :* These resources do not dwindle even with continuous use, as these are replenished by nature. These resources are inexhaustible e.g., solar energy, wind energy, tidal energy, geo-thermal energy, biogas etc.
  - *Non-renewable sources :* These resources are exhaustible, and once the sources are finished, they can never be replenished. Nature also cannot replenish such resources, e.g. coal, petroleum and petroleum products, nuclear minerals like uranium and thorium.
- **Renewable Source :**
  - *Solar energy :* Among the nonconventional sources of energy , solar energy constitutes a large part. The heat and light radiated from the sun is called solar energy. The amount of the sun's radiation on the earth's atmosphere is 170 trillion kilowatt. We get the sun's rays profusely for at least 250-300 days of the year. The easiest and simplest mode of using solar energy is through the solar heat conversion method. Solar energy is already used in cookers, heaters, solar batteries etc. Efforts have been made to use solar energy refrigerators, airconditioners etc. Street lamps run with solar power are available in the market today. The quality of these products needs to be improved and the prices should be reasonable so that the common man is able to purchase them.
  - *Wind energy* **:** Wind energy can be used in the production of power and for spraying water. Wind energy can be converted to mechanical and electrical energy. Wind driven water pipes have been installed. Since in the coastal areas like the Kutch region of Gujarat, Okha, Puri and Tuticorin, the wind speed is very high, wind driven turbines are used to generate electricity.

- *Tidal energy :* In Gujarat's Kutch region and west Bengal's Sundarban Delta, experiments are being made on the usefulness of tidal energy. The most powerful tidal energy production centre in the world is located in France.
- *Hydro power :* Dams are constructed in fast flowing rivers in order to create hydro energy. River water is collected by constructing dams. The accumulated water is allowed to flow through the dams where the water energy is converted from static to dynamic form. These rapid flowing waters start rotating the turbines and the attached generators which lead to electricity production. The amount of hydroelectricity production in India is nearly 23800 megawatt.

  Some problems arising out of hydroelectricity generation through dams are –
  - The flow of water may be stopped if sediments accumulate in the dams.
  - Obstruction due to migration of fish
  - Preventing river water flow, and preventing the use of higher lands due to floods.
- *Ocean thermal energy:* The energy which is created due to fluctuations in temperature between the surface and depth of the oceans is called ocean thermal energy. This energy is used to generate electricity.
- *Geothermal energy* : The heat generated by the hot molten materials inside the earth's core is called geo-thermal energy. Hot springs are to be found in Manikaran, Kullu (Himachal Pradesh), Sohna (Haryana), Garampani (Assam) etc. The warm water which flows at high pressure can sometime be used to rotate the turbine in the generator in order to produce electricity.
- *Biomass energy:* Biotic elements like wood, garbage, agricultural wastes etc. constitute the biomass The energy released from these elements are as follows–
  - Energy producing agriculture lands: Photosynthesis uses carbon dioxide and water, and through solar energy, transforms it into

essential foods. Through this process, solar energy is transformed into bio mass energy. Some fast-growing plants are also directly burned to produce energy. Decomposition turns it into fuel.

- ❍ Petro-Plants : Plants like euphorbias, Jatropha have been identified as the source of liquid hydrocarbons. It supplements liquid fuel. These oily particles can be used to produce diesel or gasoline. Liquid fuel can also be extracted from the seeds of the 'nahar' tree.
- ❍ Agricultural and urban refuse, when burnt, produces energy which can be used for different purposes.

➢ *Bio-gas :* The reaction of bacteria on biomass produces bio gas. The number of biogas plants in India is 30,00,000. Bio gas is formed from a mixture of methane, carbon dioxide, hydrogen sulphide and ammonia. The composition of plant and animal refuse also creates these gases.

In different parts of the country dung cakes are used for cooking and other purposes. The wastes of animals contain certain nutrients which are helpful if returned to the soil. The dung cakes do not get fully burnt, and therefore, they create a lot of smoke, and pollute the air. Instead of directly burning the dung cakes, it helps to transform it into biogas first. This fuel is clean and also generates heat. While producing fuel, the residue left behind can be used as fertilizer for agriculture.

➢ *Bio-gas project:* The plant and animal waste rot easily in water when microbes work on them. This process also produces methane, carbon dioxide, hydrogen and hydrogen sulphide gases. The mixture of these gases is called bio-gas. Methane constitutes 65% of this gas. It is one of the best fuels. This mixture of dung and water, when poured into a part of the project, produces a gas which is let out through an outlet pipe for the users. In order to have a continuous supply of biogas, it is necessary to fill the mixture room with wastes

from the biotic community. Human waste can also be added to it. In some places, household refuse can also be used as raw material for the biogas project. In our country, we have basically two types of biogas projects– (i) Fixed pile bio gas project, (ii) Floating gaseous biogas project

- Advantages of Bio-gas Project :
  (a) Its use in gas stove
  (b) Its use in street lights and mechanical engines.
  (c) It prevents water pollution
  (d) The burning of biogas does not produce smoke, but produces much heat.
  (e) The residue left after the extraction of gas can be used as fertilizer. It contains a lot of nitrogen and phosphorous compounds.

- *Bio fuel :*Types of alcohol like ethanol and methanol can be produced by the decomposition of biotic microorganism. Ethane can be produced from sugarcane. Like ethanol, methanol is also a clean, non- polluting fuel. Methane can be produced frome woody plants. It burns in a lower temperature than gasoline and diesel. The mixed product of ethane and methane is gasoline. In many countries, it is also used as car fuel.
- *Hydrogen :*The burning of hydrogen in the atmosphere creates a lot of energy. Hydrogen can be produced through two methods – a) Thermal dissociation and b) Photolysis or electrolysis of water.
  - The advantages of the use of hydrogen as fuel :
    a. It is non polluting.
    b. It can be produced very easily
    c. Since it has a huge amount of improved calories, it is suitable for use as fuel.
  - The disadvantages are as follow :
    a. It is highly inflammable and explosive
    b. it is difficult to store and transport

- **Non-renewable Sources of Energy :**
  - *Coal :* Energy produced through the burning of coal can be used in various ways. Coal is a non renewable source. The earth's crustal layer contains nearly 6000 million tons of coal. Till now, almost 200 million tons have already been used for various purposes. Some of the big coal mines in our country are – Raniganj, Jharia, East Bokaro, West Bokaro, Pulse Kungkom, Singrauli, Talser, Chanda, The states which have huge amount of coal are – Bihar, Orissa, West Bengal, Madhya Pradesh, Andhra Pradesh, and Maharastra. Assam and Meghalaya also have coal. India constitutes 5% of the world's coal. Coal is of 3 types – a) Anthracite (Hard coal), b) Bituminous (Soft coal) c) Lignite.

    Coal is a huge source of energy and is very useful for industries. The amount of coal at present in India is about 123000 million tons. 75% of the produced coal is used in trains, industries and thermo-electric projects.
  - *Petroleum :* It has been estimated that the crude oil source will last only for the next 40 years or so. The 13 countries of the OPEC constitute 67% of the world's petroleum. Saudi Arab contains 25% of the crude bio resourse.

    Crude oil is refined through the partial distillation process and thereby different fuel products such as petrol, diesel, kerosene gasoline, plastic etc are produced. Compared to coal, petroleum is a clean fuel and can also be transported.
  - *Liquefied Petroleum Gas (LPG)* : Petroleum gas can be liquefied through high pressure. This is known as LPG, which is used as cooking fuel. Now-a-days, it is also used to run vehicles.
  - *Natural Gas :* Natural gas mainly contains methane but also some amount of propane and ethane, In India, natural gas is a gift of nature. It can be used both as an energy source and as industrial raw material in petrochemical industries. Natural gas is also used in fertilizer production centres. This gas burns without producing

smoke. Natural gas is of two kind – Compressed Natural Gas and Synthetic Natural Gas.

- Compressed Natural Gas (CNG) : CNG is presently used as fuel for vehicles. Use of CNG in Delhi has reduced pollution to a large extent.
- Synthetic Natural Gas (SNG) : SNG is produced from a mixture of carbon monoxide and hydrogen. Low quality coal can be converted into artificial gas.

➢ *Nuclear gas :* A very little amount of radioactive products can produce a large amount of energy. Atomic energy is produced through nuclear emission. Two methods are used to produce energy. These are - nuclear fission and nuclear fusion. In India, there are 4 nuclear energy production centres, and these produce 2005 megawatt energy. Nuclear energy is used for –

- Electricity production
- Fuel for ocean liners
- Heat producers in chemical reaction projects.
- To fly aeroplanes



CHECK YOUR PROGRESS

Q 9. How many kinds of energy are there and what are these?

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Q 10. Mention the types of coal.

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2.10 LAND RESOURCES

The upper surface of the earth is called land. Everything that is required for sustenance on this earth can be acquired from it. 43% of India's

land mass is constituted by plains, 27% by plateaus and 30% by mountains. When physical elements like eroded hills, rain, air, temperature etc. react with biotic elements like plants, animals, and micro organisms, land is formed. There are four elements which constitute land –

Mineral elements	–	50-60%
Biotic elements	–	10%
Water	–	25 – 35%
Air	-	15-25%

600 million hectares of agricultural land in India are ruined due to various factors such as – soil erosion, increased salinity in the soil, mixing of poisonous substances with the soil etc.

- **Soil Erosion:** Soil ersion is the transference of the upper part of the soil from one place to another. It is only after 500-1000 years that one inch thick layer of the earth's surface is formed. Today, soil erosion is a worldwide problem.
- **Types of Soil Erosion:**
  - *Natural or geological erosion:* When erosion occurs naturally without human interference, it is called natural or geological erosion.
  - *Rapid soil erosion:* When men and other animals interfere with nature, then soil erosion becomes more rapid. Excessive grazing, deforestation, mining etc contribute to the speedy erosion of soil. Soil erosion occurs due to various factors. For example –
  - *Through water:* Water erodes soil in four ways – Erosion of the land surface, Erosion through streams, Erosion by creating canals, Erosion of the river banks
    - Erosion of the land surface : This occurs when heavy rainfall completely washes away the surface layer of the soil.
    - Erosion through streams : When heavy rainfall cuts through the soil then it erodes the soil.
    - Erosion by creating canals : When water flows swiftly, it sometimes erodes land by creating wells and canals.
    - Erosion of the river banks : Rivers which have strong currents erode the nearby areas under water and as a result, the upper

surface becomes unstable and gets washed away. Thus, the river banks get eroded.

- *Erosion by wind* : Barren lands or land with few trees suffer from erosion by air. Particularly the desert and dry lands suffer from this problem. In India, Rajasthan, the Kutch region, and the arid region of Madhya Pradesh, have this problem. The fine dust particles are blown away from one place to another by storms and heavy winds. When the wind stops or is obstructed, the loose particles create sanddune. The causes for the formation of dune are – saltation, suspension and surface creep.

- **Soil conservation practices:** The objective of soil conservation is to keep the soil as it is and to preserve soil fertility in order to make it conducive for agriculture. The easiest and cheapest way to conserve soil is to plant trees. There are also other methods of soil conservation. They are –
  - *Farming plots of land one by one:* If rice, wheat and pulses are cultivated in turns, it helps soil conservation.
  - *Preserving soil fertility:* Infertile lands are easily eroded by air and water. Therefore, in order to prevent soil erosion, it is necessary to protect soil fertility using fertilizers and planting pulse like crops which can protect soil fertility.
  - *Afforestation :* When water falls down a precipice, soil erosion occurs more quickly. In order to prevent the erosion trees, grass should be planted. When huge trees like 'Shirish', 'Palash', 'Sonaru' etc. are planted, the falling leaves form a thick layer of humus on the surface of the soil.
  - *Terrace Cultivation :* When a mountain slope is cultivated in small parts step by step, it is called terrace cultivation. When a slope is thus cultivated by cutting it into parts, the flow of water can be controlled and soil erosion can be checked.
  - *Construction of check dams :* Constructing check dams on streams can reduce the speed of water and stop soil erosion.

- *Crop rotation :* Together with other crops, if pulses are cultivated in rotation, soil erosion can be reduced to a large extent.
- *Controlling streams :* When water flows down the mountain slopes at a great speed, it creates deep channels and aggravates soil erosion. This can be checked by constructing dams. Grass, bushes and hedges can stop the land from cracking up and getting eroded.

- **Prevention of damages caused by wind:** Erosion caused by wind can be stopped by different methods. Planting green grass, keeping the ground uneven, crop rotation etc. are some of the ways through which erosion by wind can be stopped. The forests created by excessive planting is called Shelter Belt. Trees reduce the speed of winds, and protect the soil particles carried by the wind.

  Rajasthan in India suffers most from wind erosion. The Central Arid Research Institute in Jabbalpur is involved in carrying out research on how to reduce and control erosion by wind.
- **Landslides:** Constructing dams for hydro-electronic projects, constructing roads and highways, digging reservoirs, laying rail lines, etc. involve cutting the earth and, as a result, landslides frequently occur on hillsides. Heavy rainfall washes away the top layer of the soil and the rocks move down due to gravity causing huge landslides. Landslides in the North-eastern region cause death to a large number of people annually.
- **Desertification:** Destruction of forests has led some regions to desertification. This results in soil infertility, reduction of ground water, salinity in the soil, and increase in soil erosion. Misuse of land results in desertification. Its ill effects lead to – (i) Weakening of the food chain and (ii) Appearance of exotic plants.

  Desertification take place because of the following factors –

  - *Deforestation and excessive animal grazing :* Destruction of forests, and excessive animal grazing lead to erosion of soil. Animal grazing is becoming a threat to grassland forests and mountain regions. The wind erosion caused by deforestation, when not checked, leads

to reduction in the amount of rainfall. In order to prevent excessive animal grazing, goats and sheep should be kept in enclosures, and fed only on cut grass.

- *Mining and quarry extraction :* Desertification also happens when mining is done to extract mineral salts and other minerals. Mining results in the extinction of many plants. In order to prevent desertification, environment friendly mining methods should be used.



CHECK YOUR PROGRESS

Q 11. Mention the elements of soil in percentage.

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Q 12. What are the effects of desertification?

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2.11 CONSERVATION OF NATURAL RESOURCES

In order to sustain the growing population, natural resources are being used recklessly, which in turn, has reduced their quantity. Nature takes a lot of time to remedy the wrongs done by man. Afforestation after deforestation requires both time and energy. After plantation nature requires time to nurture the saplings and bring them up.

- **Conservation Practices:**
  - Keep a balance between resources and man's needs
  - Proper planning for proper use of resources.
  - Environmental knowledge and awareness.
- **Objectives of conservation of natural resources:** Natural resources need to be conserved both for our own good and the good of our future generations. Its objectives are –
  - The conservation of the natural resourese is essential for controlling the environmental system. This means the controlling of various environmental system such as food-chain, renewal of mineral

resourses, maintainance of the supporting condition like soil, wind, water, animals.

- It makes the resources available and their existence pereanial so that all living beings can lead an undistrubed life.
- To keep conservation at a specific level in order to maintain the biodiversity for ensuring safe evalution of life.

- **Some methods for conservation of natural resources:**
  - *For conserving water:*
    - We should not keep the water taps open unnecessarily. When not in use, the taps should be tightly closed.
    - Use of water for domestic purposes should be properly regulated.
    - We should water the plants only in the evening.
    - Store rain water for later use.
    - Controlled use of water for irrigation and sprinkling of water on the green.
    - Clean water should be used in irrigation.
    - We should be careful and thrifty while using water both at home and in industries.
  - *For conserving energy:*
    - We should develop alternative sources of energy like solar energy, nuclear energy for everyday use.
    - We should be careful while using fuel for extracting energy so that the fuel is not wasted. Only when there is no alternative fossil fuels should be used. In this way, fossil fuels can be preserved.
    - Misuse of energy can be stopped by the following ways –
      (a) As far as possible we are to use the most efficient fuels .
      (b) For burning fuels, efficient cooking implements like stoves and chulhas should be used.

Excessive use of coal, crude oil and natural gas has led to a depletion of these resources. It is necessary to find renewable sources of energy as an alternative, and to stop the misuse of these types of fuels. In the today's context, it is necessary to modify the models of houses,

industries, business, hospitals, schools, colleges, factories etc. Change in life style will encourage energy conservation, as saving energy will create energy.

- *For conserving soil :*
  - It is necessary to preserve soil fertility to grow more food grains for the increasing population. Soil fertility can be increased in the following ways – Supplying fertilizers; using green fertilizers, stabilizing organic nitrogen. The decomposition of fallen leaves, dead animals etc. can provide mineral fertilizers.
  - Soil erosion can be stopped in the following ways –
    i) Crop rotation methods
    ii) Planting grass, pulses, groundnuts etc.
    iii) Drains or canals should be dug to drain out floodwaters
    iv) Afforestation
    v) Controlled animal grazing
    vi) Cutting steps on slopes in order to stem the flow of water.

- **Equitable Distribution of Fuel:** America, Canada, Japan, Australia and other developed countries constitute only 22% of the world's total population. But this population utilises 88% of the total resources. They cntrol 73% of the power and 85% of this their earnings. It is seen that there is a vast difference between developing and developed countries in fuel use. Because of this imbalance, the rich countries are becoming richer.

  For this reason, it is necessary to share the natural resources equitably between the rich and the poor. Equitable distribution is required especially for the basic necessities– water, food and fuel. It will be difficult, rather impossible to control pollution, unhygienic conditions etc. in the developing countries without the intervention of the developed countries.

  Developed countries should therefore intevence in favour of shifting resources to the poor countries. This will lead to equitable sharing of developmental works, bridging the gap between the rich and the poor and establishing balanced, equal development everywhere.

2.12 SUSTAINABLE DEVELOPMENT

All the essential requirements of man such as air, water, food, shelter etc. can be acquired from the environment. The economic development of man has adversely affected the resources given by nature such as minerals, plants and animal kingdom, which in consequence has led to a depletion of these resources. Population explosion is also a contributing factor towards environmental imbalance.

Environment cannot be separated from economic development. Different developmental works contribute to the destruction of natural resources. The degradation of natural resources has a harmful effect on the economic development. There is an intimate relation between environmental imbalance, disaster and scarcity of fuel etc. Such imbalances creat problem and cause disasters. The accelerated rates of development have broyght immense pressure on the use of raw materials from forests and other land areas.

If this development process continues, then it will be most difficult to maintain an environmental balance in the world. Therefore, in recent times a new concept has emerged worldwide, which is called sustainable development. Sustainable development means the capacity to cater to the present needs of the people of a certain geographical region without affecting the interests of the future generations. The sustenance capacity depends upon land area, its productivity and the proportion to the essential requisites of man.

Therefore, when a country or a region marches towards economic progress or development through the proper use of its resources and by maintaining the environmental balance sustainable development occurs and it meets the essential requirments of men and ensures their availability in the future without destroying the environmental resources.

According to the world organization of environment and development, the following areas need to be considered for sustainable development in the local, regional and national levels.

- **Political System :** Citizens should take decisions through active participation.

- **Economic System :** Increase in production through the use of technology.
- **Social System :** Removal of the anxiety and concern which stem from unequal development.
- **Productive System :** Preserving the ecosystem for progress, and to recognize our responsibility towards it.
- **Technical System :** Find solutions through research
- **Government System :** To have the capacity for self correction, and to become humble.
- **National Foreign Policy :** To sustain business and economy through international agreements.

It is feared that unsustainable economic development will destroy the environment as it causes great strain on the resources. Therefore, the policy makers of the country need to be motivated by the thoughts of sustainable development. This will enable the growing economy to have a firm grip on the roots of the ecosystem. This system needs to be protected and cared for, in order to continue it till posterity.



CHECK YOUR PROGRESS

Q 13. What are the objectives of the conservation of natural resources?

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Q 14. What do you mean by sustainable development?

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LET US KNOW

Resources : Storehouse of necessary materials.

Atmosphere : The layer of transparent gases covering the earth.

Living energy	:	Energy extracted from living beings.
Living community	:	Organic elements from living beings.
Bio-gas	:	Gas produced from the decomposition of microbes in garbage
Inexhaustible resources	:	Those resources which cannot be exhausted with continuous use.
LPG	:	Liquefied Petroleum gas
O.T.E.	:	Ocean Thermal energy
Non-renewable resources	:	Resources which cannot be renewed.
Renewable resources	:	Resources which are produced spontaneously by nature.
Soil Erosion	:	The transference of the upper layer of the land surface from one place to another.



2.13 LET US SUM UP

- After going through this unit, we have acquired a holistic idea of natural resources. We have come to know about the types of natural resources and where these resources are to be found and in what state.
- Beside knowing about renewable and non-renewable resources, we have also understood how to use them in a proper manner.
- We have learnt about environmental imbalance as created by deforestation.
- Natural gases and the reserves of petroleum and petroleum products will become extinct one day. So, we have been acquainted with the means to use the resources in a proper way in order to maintain the natural balance. Finally, we also got some idea about sustainable development which is closely related to the above mentioned issues.



2.14 FURTHER READING

1) Asthana, D. K. & Meera A. (2012) *A Textbook of Environmental Studies*. New Delhi: S. Chand and Company Ltd.
2) Bharucha, E. (2004). *A Textbook of Environmental Studies.* New Delhi: UGC.
3) Kaushik, A. & Kaushik, C. P.(2006) *Perspectives in Environmental Studies.* India: New Age Publications (Academic).



2.15 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: Air, sand, solar radiation, etc are examples of inexhaustible resources. Water, wood, natural grasslands, soil and biotic matter, forests, wild animals, fossil fuels (coal, petrol), minerals like copper,iron etc are exhaustible resources.

Ans to Q No 2: Deforestation results in soil erosion, increase in floods and drought, reduction in the profits derived from flora and fauna, scarcity in wood and energy resources etc.

Ans to Q No 3: If rainfall occurs 75 % less than the usual amount, then drought situation occurs.

Ans to Q No 4:
- Destruction of forests, plants and animals along with it.
- Displacement of tribal people.
- Fundamental changes in the climate.
- Occurrence of diseases like malaria etc.

Ans to Q No 5: Mineral resources are of two types-

(i) Non metallic e.g. Diamonds, Graphite, Quartz.

(ii) Metallic, e.g. Bauxite, laterite etc.

Ans to Q No 6: ● Destruction of plants ● Geographical changes

- Depression of the earth surface
- Poisoning of ground water
- Air pollution.

Ans to Q No 7: Food products include carbohydrates, proteins, fats, bio-acids, vitamins, mineral salts etc.

Ans to Q No 8: (i) Use of better quality water

(ii) Spreading the inland network through open canals.

Ans to Q No 9:
- Solar energy
- Hydro power
- Nuclear energy
- Wind energy
- Bio mass energy

Ans to Q No 10: Coal is of 3 types – (i) Anthracite (Hard coal), (ii) Bituminous (Soft coal) (iii) Lignite.

Ans to Q No 11: Mineral elements – 50-60%

Biotic elements – 10%

Water – 25 – 35%

Air - 15-25%

Ans to Q No 12: (i) Weakening of the food chain

(ii) Appearance of exotic plants.

Ans to Q No 13: Following are the objective of the conservation of natural resources:

- The conservation of the natural resourese is essential for controlling the environmental system. By this is meant the controlling of various environmental system such as food-chain, renewal of mineral resourses, maintainenca of the supporting condition like soil, wind, water, animals.
- It makes the resources available and their existance perennial so that all living beings can lead an undistrubed life.
- To keep conservation at a specific level in order to maintain the biodiversity for ensuring safe evalution of life.

Ans to Q No 14: Sustainable development means the capacity to cater to the present needs of the people of a certain geographical region without hampering the interests of future generation.

The sustenance capacity depends upon land area, its productivity and the amount of everything that is required for man.



2.16 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. What are resources?

Q 2. What are the natural resources?

Q 3. What is pesticide?

Q 4. Give the full form of DDT.

Q 5. Write the names of some inexhaustible natural resources.

Q 6. What is energy? Why is it necessary?

Q 7. What is deforestation?

Q 8. What is a drought situation?

Q 9. Write the names of some alternative sources of energy.

SHORT ANSWER QUESTIONS

Q 1. What are the uses of forest resources?

Q 2. Describe the reasons for deforestation.

Q 3. Discuss the impacts of the constraction of dams forests and man.

Q 4. What are the different types of water? Describe its importance.

Q 5. What are the problems of modern methods of agriculture?

Q 6. What are the environmental effects of mineral extraction?

Q 7. Write short notes on :

(a) Floods, (b) Drought, (c) Marine resources (d) Solar Energy (e) Geo thermal energy (f) Bio-gas (g) Bio-fuel.

LONG ANSWER QUESTIONS

Q 1. Account for the importance of forest resources.

Q 2. Write an essay on water resources.

Q 3. Describe the mineral resources in terms of their types, use and the environmental impact of thir extraction.

Q 4. Discuss the renewable and non-renewable sources of energy.

Q 5. Elaborate on the land resources.

Q 6. Discuss the different types of energy.

Q 7. Write short notes on :

(a) Soil erosion, (b) Soil conservation,

(c) Responsibility of man towards conservation of natural resources

(d) Sustainable development.

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UNIT 3 : ECOSYSTEM

UNIT STRUCTURE

3.1 Learning Objectives

3.2 Introduction

3.3 Ecosystem

3.4 Food Chain

3.5 Food Web

3.6 Energy Flow

3.7 Ecological Pyramid

3.8 Main Ecosystems

3.9 Let us sum up

3.10 Further reading

3.11 Answers to check your progress

3.12 Possible questions

3.1 LEARNING OBJECTIVES

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

- describe an ecosystem, its types and structure,
- get an idea about the productivity of the ecosystem, its elements and its trophic structure,
- acquire knowledge about food chain and food web, and how it is helpful to us,
- discuss energy flow in an ecosystem
- get a comprihensive idea about the ecological pyramid and its different types,
- discuss the important ecosystems.

3.2 INTRODUCTION

The word ‘ecology’ was used by the German scientist Ernest Hekel in 1869. The term means the study of the environment. The term ‘ecology’ has come from the Greek word ‘Oikos’, Oikos meaning ‘house’, and ‘logos’

meaning 'study of'. In other words, ecology is the study of the relationship among living beings and their relation with the environment. The group formed by the reproduction of a particular species within a specific geographical area is called a population. The population of different species together is called a biotic community. There exists inter-specific and intra-specific relations and dependence within a biotic community. It is not possible for a population or community to live in isolation. The environment in which the biotic community lives provides it with all the necessary ingredients and energy for its survival. This results in an inseparable relationship between the living beings and the environment.

In this unit, you will learn about the ecosystem, food chain, food web, energy flow, ecological pyramid etc. You will also learn about some important ecosystems.

3.3 ECOSYSTEM

The term 'ecosystem' (Greek: Eco-environment, system: action: reaction or interaction and inter dependence) was first used by A.G. Tansley in 1935. Russian ecologist Sukachev defined it as *Biogeo coerosis* in 1944. The intermingling of the organic and inorganic elements in the environment is called the ecosystem. The chemical cycle through which energy flows to the bio-diversity, food chain and material cycle etc. help create action and reaction within the intermixture. This is called ecological system. According to Odum (1963), ecosystem is the main active unit of ecology.

- **Types of ecosystem:** There are different types of ecosystems in our environment. These are:
  - *Natural and permanent ecosystem:* This ecosystem becomes effective in a natural environment without human interference. This system is of two types –
    - Terrestrial ecosystem : This system is effective on land, e.g. grassland ecosystem, desert ecosystem and forest ecosystem.
    - Aquatic ecosystem : This system is effective in water. It is of two types:

(i) Freshwater ecosystem : This works in streams, ponds and lakes.

(ii) Marine ecosystem : This works in seas, oceans and bays.

- *Temporary and natural ecosystem:* This system is effective in a natural environment, but it is temporary and dependant on rainfall.
- *Artificial or man-made ecosystem:* These are created by man, e.g. croplands, space ecosystem, fisheries etc. The aquarium in the drawing room is also one type of artificial ecosystem.

- **Structure of Ecosystem:** The main factors of the ecosystem are the biotic and abiotic elements.
  - *Biotic factors:* All living beings within an ecosystem are included in the biotic factors. These biotic factors are of two types depending on the mode of nutrition.
    - Autotrophic factors
    - Heterotrophic factors
    - Autotrophic factors: These include green plants, photosynthetic bacteria and cyanobacteria. These organisms can produce their own food through the use of abiotic elements like CO_2 and H_2O during photosynthesis. So, these factors can be called producers. The autotrophic factors include grass, shrubs, trees and microscopic phytoplankton.

$$6CO_2+6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Radiated energy}} C_6H_{12}O_6$$

    - Heterotrophic factors: The living beings included in these factors cannot produce their own food, and consume only pre-produced biotic food or else break down complex biotic compounds. Therefore, these factors are called consumers. Depending on their shape, the heterotrophic beings are divided into two types. They are –

(a) Macro consumers: Those animals which consume the producers either directly and indirectly are called macro consumers. These animals can be divided into four types—

(i) Primary consumers : Animals like cows, buffaloes, goats, deer, rabbits, horses etc. which directly consume plants are called primary consumers. These animals are also called herbivores.

(ii) Secondary consumers : Animals like fox, wild cats, snakes, carnivorous fish, frogs, toads, centipedes etc. live by feeding on herbivorous animals.

(iii) Tertiary consumers : Those animals which feed on secondary consumers for survival are called tertiary consumers. e.g. wolves.

(iv) Quarternary consumers : Lions, tigers etc live by feeding on tertiary consumers. These are called quarternary consumers.

(b) Micro consumers : There are certain living organisms in the environment which decompose dead plants and biotic compounds. They feed upon some of these matters and return the abiotic compounds to the environment. These organisms are called decomposers or detritivores e.g. bacteria, fungus. These organisms help in recycling matter.

- *Abiotic factors:* Physico-Chemical factors are included in this category. These can be divided into three types –
  - Abiotic matter: This includes carbon, nitrogen, carbon-dioxide, water etc. These are intimately related with the material cycle.
  - Biotic compounds : Include carbohydrates, protein, lipids, nuclei acids etc. These are found in dead biotic matter.
  - Edaphic factors : Climate, light, air, temperature etc. which are related to land are called edaphic factors.

- **Examples of Ecosystem (fresh water ponds):** Fresh water ponds are a good example of ecosystem. Pond represents a fresh water ecosystem. The study of a pond gives a comprehensive idea of the structures and function of an ecosystem.
  - *Abiotic elements :* Water, carbon dioxide, oxygen and its compounds, amino acids, humus etc are the abiotic matters of the pond

ecosystem. Adequate light, temperature and climatic conditions control the efficiency of the pond ecosystem.

- *Biotic elements:* Producers and different consumers are the biotic factors. The biotic matters found in ponds are—
  - Autotrophic consumers : Spirogyra, oscillator arabina, flagmitos, potamgaton velisner and ecocrinia are examples of autotrophic consumers.
  - Macro consumers: Paramecium, daphnia cyclops etc are zooplanktons, worms etc are primary consumers. Small fishes living in water and insects like dung beetles live by feeding on primary consumers. These together are called secondary consumers. Comparatively, big fishes consume these small organisms. These living things which live by consuming secondary consumers are called tertiary consumers.
  - Decomposers or micro consumers : The numerous bacteria and fungi which are found in muddy water are called micro consumers. The main function of the micro consumers is to decompose dead animals, plants and animal refuse and then to return the abiotic compound to the pond ecosystem. Therefore, they are called decomposers.
- *Trophic structure:* The living organisms which derive energy from the same source are said to belong to the same trophic structure. The green plants which use the sun's energy to produce food – e.g. planktons, herbs, shrubs or trees etc- are said to belong to the first trophic structure (T1). Herbivorous plants or primary consumers which depend upon the autotrophic producers for survival belong to the second (T2) trophic structure. Secondary consumers belong to the third (T3) trophic structure and the tertiary consumers belong to the fourth (T4) trophic structure. Quarternary consumers live in the T5 level, and the decomposers belong to the final or residual level in the structure. There can only be a few trophic structures in an ecosystem. This is because –

- In moving from one place to another, there is a dificiency in the food energy.
- The food is not used wholly
- A huge amount of energy is used in breathing.



CHECK YOUR PROGRESS

Q 1. What do you mean by ecosystem?

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Q 2. What are the biotic and abiotic factors?

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3.4 FOOD CHAIN

In a trophic structure, the process of eating and being eaten among the living beings helps the food energy to flow in an orderly manner. This is called the food chain. The characteristics of food chain are as follows :

- Food is consumed frequently. The big animals consume the small animals for food.
- The solar energy flows from the sun to the producers and from the producers to the consumers in one direction.
- Each time energy is transformed, 80-90% of the static energy is radiated as heat energy.
- There can be four to five trophic levels in one food chain. It may be mentioned that 6 food chains can supply enormous energy.
- Food chain is always unidirectional
- The omnivores dominate more than one trophic structure in one food chain.

Food chains are of two types– Grazing Food Chain and Detritus Food Chain.

- **Grazing Food Chain :** As a primary source of energy the grazing food chain produces food through photosynthesis using the sun's rays, and

thereby it creates the first trophic structure of the food chain. The primary consumers (herbivores) depend upon producer for survival and form the second level. On the other hand, the carnivores prey upon the herbivores. They are of many types. These food chains are long and they end in the decomposition level.

Figure 3.1 : Ideal structure of Ecosystem

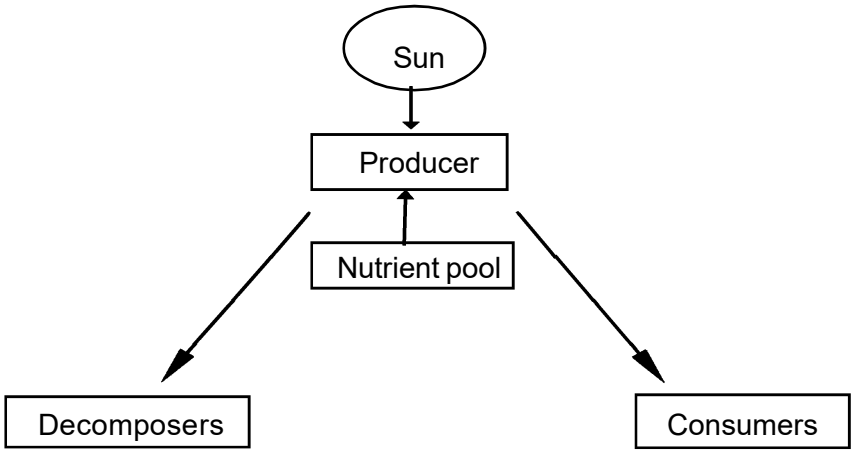


Table 3.1 : Food Chain

Types of Ecosystem	Producer	Herbivorous/ Carnivorous	Primary Carnivorous	Secondary Carnivorous	Tertiary Carnivorous
Grassland Ecosystem	Grass	Insect	Forg	Snake	Predatory Birds
	Grass	Rat/Mice	Sanke	Predatory Birds	
	Grass	Rabbit	Fox	Hyena	Lion
Pond Ecosystem	Phyto Plankton	Animal Plankton	Small Fish	Big Fish	Predatory Birds

- **Detritus Food Chain:** The dead mater is the primary source of energy of the detritus food chain. The fallen leaves and dead animals are the main sources of the dead biotic matter. Protozoa or unicellular organisms, bacteria, fungi etc are the primary consumers of decomposed matter. The insects and their larvae survive on decomposed matter. The detritus food chain is shorter than the grazing food chain.

Table 3. 2 : Grassland Food Chain

Types of Detritus	Detrivores	Detrivore Consumers	Small Carnivorous	Big Carnivorous
Mangrove Fallen Leaf Dead Bodies	Fungi Bacteria Protozoa	Insect larva Certain Crustacean Mollascs & fishes	Fish fry and Small Fish	Big size fish and fish eating Birds

3.5 FOOD WEB

The food relationship among the different living beings in the biotic community is called the *food web*. There is a web-like connection among the different trophic levels in different food chains. This is called the food web or food cycle.

No plant or animal in an ecosystem can be free of the food chain. The inter-relationship among the three types of food chain, e.g. *predatory food chain, parasitic food chain* and *necrophagous food chain*, - forms the food web. Some of the characteristics of food web are –

- Food web gives direction to an alterative means. Even though a crop may be destroyed due to disease related causes, the animals which survive on them are not affected, because of the availability of alternative sources of food. An ecosystem remains stable if alternative sources of food are available.
- The probability of alternative sources in the food web obstructs the increase in the population of the highly productive species.
- The food web especially contributes to the development of the ecosystem. e.g. Terrestrial food web.

In a grassland ecosystem, the five probable food chains mutually connect, and create a food web.

1) grass – grasshopper – predatory bird.
2) grass – grasshopper, lizard – predatory bird
3) grass – rabbit – predatory bird
4) grass – mouse/rat – predatory bird

5) grass – mouse / rat / snake – predatory bird



CHECK YOUR PROGRESS

Q 3. What is Food chain? What are its types?

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Q 4. What do you mean by Food web or Food cycle?

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3.6 ENERGY FLOW

The main function of the ecosystem is energy flow. The energy flow is governed by two main laws of thermo-dynamics. The *first law* is that – energy can neither be produced nor be destroyed; it can only be transformed from one state to another. The *second law* affirms that some amount of energy is lost in transformation.

Leaves contain chlorophyll and therefore they are green in colour. Because of the presence of chlorophyll, the plants can produce their own food using the sun's rays during photosynthesis. The biotic community that sustains itself through photosynthesis is called the primary producers of the ecosystem. The avarage percentage of radiated energy is 1-5%. The plants utilize a part of this energy during breathing.

The main features of energy flow are –

- The energy from the sun to the producers, and from the producers to the different consumers in the food chain always flows in one direction. During energy transformation, 80-90% energy utilized in metabolic activities like respiration, excretion etc is lost as heat energy. This means that in the next trophic level, only 10-20% energy is realized.
- In thermodynamics, energy flow follows both the laws mentioned above. For example–

- Lindaman (1942) through a fresh water ecosystem (a lake) has explained the model of unidirectional energy flow through a diagram, and has shown that autotrophic organisms utilize only 0.1% of the solar radiation during photosynthesis. Of the total production, 21% is used in metabolic activities, 63% in an unused state, 3% in decomposition and 13% is kept for herbivores. In case of herbivores, 30% is used in metabolic activities, 57% is left unused and 3% is used in decomposition. This means that 20% of autotrophic energy is used in secondary production. The process of energy transformation from herbivores to primary carnivores happens again and again.
- E.P. Odum (1963) has shown through a model of the energy flow in the three trophic levels that – 50% of the light energy which falls on green plants is extracted by autotrophic organisms, and only 1% is transformed to the biotic community.

  On the basis of this discussion, depending upon the energy flow, the characteristics of an ecosystem can be defined as follows :
  - Energy flows in a unidirectional manner
  - The usable energy is reduced gradually
  - The radiated energy from the sun is changed into the non-living state as heat energy.



CHECK YOUR PROGRESS

Q 5. How is the energy flow directed?

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3.7 ECOLOGICAL PYRAMID

The graphical representation of the population or biotic community in an ecosystem, the reserved energy in the different trophic levels in a

food chain is called the ecological pyramid. The concept of ecological pyramid was first suggested by the English scientist Charles Elton in 1927. Therefore, it is also known as Eltonian Pyramid. The lower, middle and upper levels of the pyramid denote the population of the producers, herbivores and carnivores respectively. The ecological pyramid can be vertical towards the top or the opposite, or it can be in the shape of a weaver's reel.

Depending upon the ecological parameter, ecological pyramid is divided into three types.

- **Pyramid of Numbers:** In this pyramid, a graphical representation of the size of the biotic population in different trophic levels is given. Grassland ecosystem and pond ecosystem are very good examples of pyramid of numbers. In the predatory food chain, even though the organisms in the trophic structure increase in size gradually, they, however, decrease in numbers. In the pond ecosystem, the phytoplankton leads to big fishes, and in the grassland ecosystem, grass leads to predatory birds. The producers are small in size, but large in numbers. On the other hand, the higher level carnivores are bigger in size but smaller in numbers.
- **Pyramid of Biomass:** The dry weight of biotic matter in an ecosystem is called biomass. The graphical representation of the biomass in per unit structure of the trophic level is called pyramid of biomass. The pyramid of biomass of the terrestrial ecosystem is always vertical. The biotic population is the largest at the producer level, and it decreases gradually towards the upper reaches of the trophic structure. In an aquatic ecosystem (pond ecosystem), the pyramid of biomass is upside down, or the apex is at the bottom. The organisms in this trophic structure depend upon the reproductive capacity and age of the community because the number of zooplanktons is more than thet of the phytoplankton, but less than the secondary consumers.

Figure 3.2 : Pyramid of biomass (Pond ecosystem)

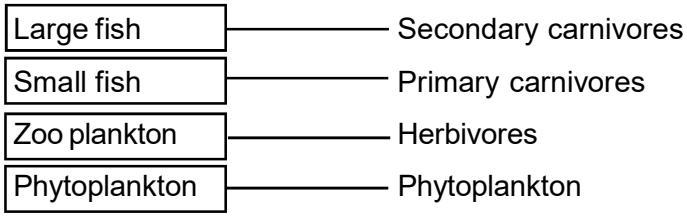


Figure 3.3: Pyramid of Biomass (Terrestrial ecosystem)

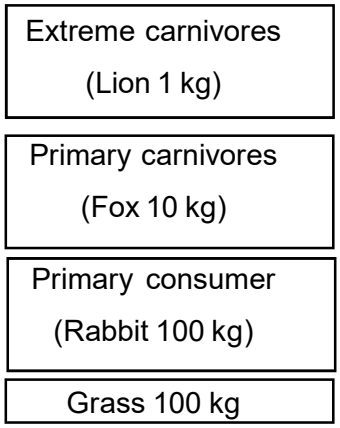
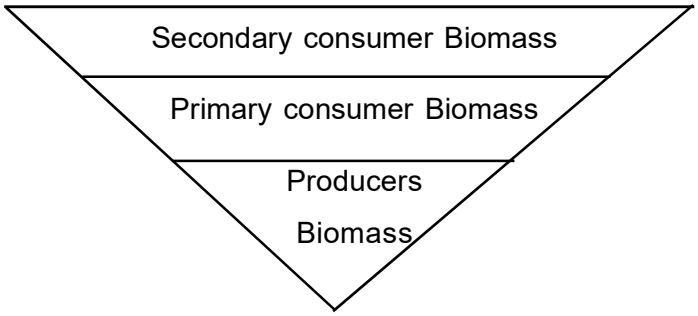
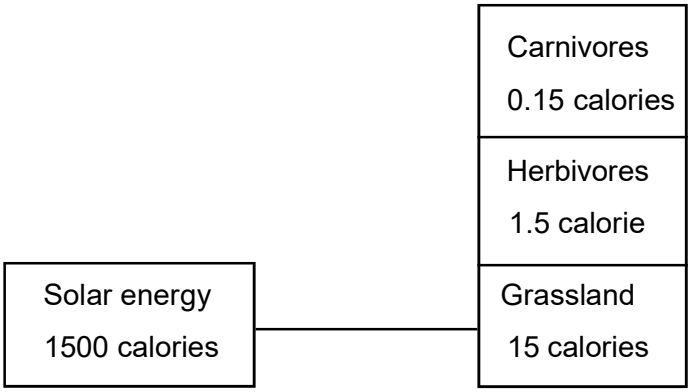


Figure 3.4: Inverted pyramid of biomass (Pond ecosystem)



- **Pyramid of Energy:** The graphical representation of the amount of energy per unit area and per unit time in a trophic structure is called pyramid of energy. According to the second law of thermodynamics, each time energy moves from the lower trophic levels to the higher levels, 80-90% of the energy is made available for the autotrophic. The herbivores and carnivores get 10% and 20% energy respectively for metabolic activities. In each trophic structure, 10% chemical energy is saved. Lindaman first proposed this chemical reaction in 1942, Pyramid of energy is always straight and vertical.

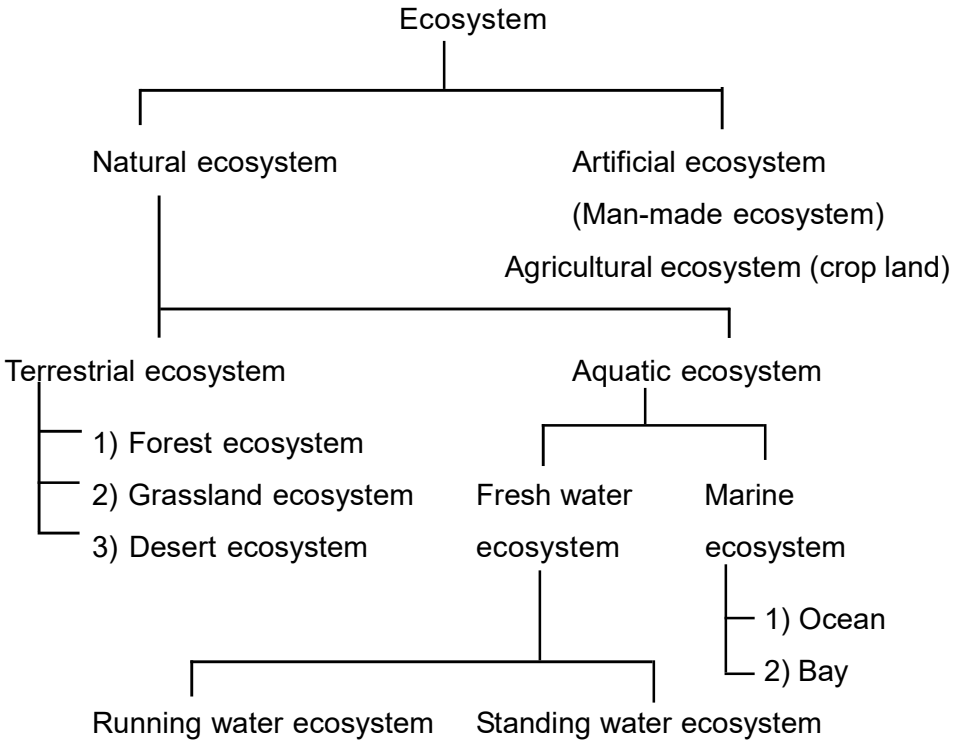
Figure 3.5: Pyramid of energy



3.8 MAIN ECOSYSTEMS

There are three types of ecosystems in the environment (i) *Terrestrial ecosystem, (ii) Fresh water ecosystem, (iii) Marine Ecosystem.* The plants and animals residing in a specific geographical region is called biomass. The condition of plants is dependent upon various physical factors like the type of soil, rainfall, amount of light, time etc.

Table 3.2 :Different Ecosystems in the World



Running water ecosystem Standing water ecosystem

1) River ecosystem
2) Brook ecosystem
3) Stream ecosystem

1) Lake ecosystem
2) Pond ecosystem



CHECK YOUR PROGRESS

Q 6. Who propagated the concept of ecological pyramid?

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Q 7. What are the main ecosystems?

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ACTIVITY – 3.1

Discuss broadly the different ecosystems of the world.

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- **Terrestrial ecosystem**
  - *Forest ecosystem*

The forest ecosystems are of different types, namely –

- Evergreen forest ecosystem
- Coniferous forest
- Deciduous forest

Evergreen forest ecosystems are also known as tropical rainforests. It covers an area of $20X10^6$ square kilometers. This constitutes $^1/_{12}$ of the earth. Evergreen forests are found in different parts of the world, e.g. Mexico, South America (Amazon and Orinock river basin), African Congo river basin, South-east Asia etc. In India,

rainforests are found in the Western Ghats, Andamans, North-East Himalayas (Assam) etc. Almost half the population of plants and animals in the world are found in these regions. Therefore, the rainforests are rich in biodiversity. It is also very productive. In the rainforests, 1200 kilo calories of energy are produced per square metre per year. The main characteristics of rainforests as

- Its temperature is high (23^0 to 27^0C)
- Every year, 200-1000cm of rainfall occurs
- Warm and moist climate
- Contains sufficient quantities of minerals and humus
- The height of plants depends upon the species. Some trees grow up to 30-40 metres.
- Plants which can grow in the shadow of big trees, like, bamboo, ferns and other shrubs also exist.
- 70-80% insects and 80-85% birds reside in the rainforests. Other animals which live in these forests are monkeys, langur, snakes, ant- eaters, bats, cheetah etc.
- The main trees of the rainforests are rosewood, mahogany, dimro, nutmeg etc.

➢ *Grassland ecosystem:* The main grasslands of the world are the plains of Europe and Asia, the Prairies of north America and Canada, the Pampas of South America, the Tuscus of New Zealand and Veldts of Africa etc. The largest grasslands are the Plains of Russia and Siberia. It covers almost $9X10^6$ square km area. It has been ascertained that every year, 2500 kilo calories of energy is produced per sq. meter in these grasslands. The main characteristics of the grassland region are:

- The amount of rainfall every year is 25-95 cm
- Amount of humus in the soil is more
- The plants are different varieties of short and long grass. E.g. Andropagan Panicam, Desmodium, Cyanodon.
- The animals are primary consumers, grazing mammals (eg. bison, antelope, zebra, big-horned sheep and deer), and animals

living in burrows (e.g. Rat, rabbit, prairie dog and land squirrels). These herbivorous animals are food for wolves and predatory birds.

- These grasslands are very useful for crop production and cow rearing.

- *Desert ecosystem:* 20% (1/5th) of the world's land area is desert. Some famous deserts are mainly in south-west America (the famous west desert Death Valley) Mexico, Peru, North Africa (Sahara and Kalahari), China (Tibet, Gobi), India (Thar), South America (Atacama) and Mid-Australian region (Tanami Gibson, Victorian) etc. The main characteristics of the desert ecosystem are :
  - Amount of rainfall is 5-25 cm only.
  - Climate is extremely dry.
  - Too hot in daytime and too cold at night
  - Population of plants and animals is much less.
  - Among the plants, shrubs and small trees can be found sparingly. Some plants are seen growing only in the rains. They have a very short shelf life (10-14days) e.g. Boerhaavia. Some plants can retain water, eg. Hardy Grass. Some other plants can live for long, eg. Dates. Some plants are fleshy and juicy, e.g. Cacti, Euphabia.
  - The chief animal of the desert is the camel. In addition, there are also kangaroos, rats, rabbits, foxes, cats and some other mammals. Among reptiles, there are horned lizards; among birds, there are insectiovorous birds, owls; and among the insects, there are ants, wasps, centipedes, spiders etc.

- **Aquatic ecosystem:** Water constitutes 71% of the total volume of the earth. Only 29% is land. Therefore, the number of aquatic ecosystems is more. Aquatic ecosystem is mainly of two types – *Freshwater ecosystem and marine ecosystem.*
  - *Freshwater ecosystem* : It is of two types –
    - Standing water (lake and pond)
    - Running water (stream, river)

❍ Standing water (lake and pond) :

Lake Ecosystem: Lakes and ponds are standing water bodies. Lakes are large in size and also deep. Lakes are classified on the basis of productivity and physical factors. Deep lakes are divided on the basis of the capacity of light to penetrate its depth.

(a) Spilimnion – the surface temperature becomes 11-12^{0}C because of the sun's heat in the summer; it becomes cold in winter.

(b) Hypolimnion – Deep surfaces are always cool (5^{0}C)

(c) Thermocline – There is variation in heat.

Depending upon productivity, lakes are divided into two types –

First : Eutrophic lake : Its depth is less. There are large number of bio producers, but the amount of oxygen is less. The circulation of nutrition is frequent. e.g. Kashimir's Dal Lake.

Second:Oligotrophic lake. These lakes are generally quite deep. The mountain inside the lakes are called vidges.They are Circulation of nutrition is also less.

Pond Ecosystem: The plants found in ponds are :

a) Those which can be seen with the help of microscopes like chlamydomones, chlorella, spirogyra, eugonium, zygnema,

b) Those which floted on water such as – floating plants like cerataphylum, articularia, hydrila,

c) Floating plants like ozola, wolphia, salvinia, pigtia lemona, echornia etc.

d) Plants with roots like vallisnaria, nelumb, typha etc. The roots of saggitaria, frogomytes can however be seen.

Among animals, there are zoo planktons like ciliates and flagellata protozoa, rotifera, daphnia, cyclops, haylly, dragonfly, damal fly; nekton like- water boatman, beetles, water insects, fish, frog, turtles, snakes etc. and those that live in the depths like hydra, prawns, crabs and the different varieties of snails etc.

- ❍ Running water ecosystem (Stream, river) : Running water ecosystem is also known as flotic ecosystem. In this ecosystem, water always flows and it is always changing.

➢ *Marine Ecosystem:* Marine ecosystem is of three types: *open seas, coastal regions, and bay regions.* The main feature of the marine ecosystem is that its water is salty (average salinity 3.5%). The salt content varies according to the depth. The factors responsible for the limitation of the biotic community are the temperature of the sea, salinity, water pressure, and light. As the depth of the sea increases, the water pressure also increases.



LET US KNOW

Words to remember-

- ➢ Biogeocirnosis
- ➢ Aquarium
- ➢ Heterotrophic
- ➢ Ecological system
- ➢ Autotrophic
- ➢ Biome
- ➢ Ecological Pyramid
- ➢ Food chain
- ➢ Food web
- ➢ Primary productivity
- ➢ Secondary productivity
- ➢ Trophic level



CHECK YOUR PROGRESS

Q 8. What are the main characteristics of the rainforests?

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.....

Q 9. Where in India can you find desert ecosystem?

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Q 10. Write the names of some plants and animals found in the pond ecosystem.

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3.9 LET US SUM UP

- After going through this unit, we have come to learn about ecosystem. There are different ecosystems in the world, namely forest ecosystem, grassland ecosystem, desert ecosystem and acquatic ecosystem.
- All these different types of ecosystem are discussed in detail. Besides, the unit also deals with food-chain, food web, ecological pyramids etc. We also got a comprehensive idea about food chain, food web, ecological pyramid etc. We have learnt that the pond we see everyday contains different plants and animals, which develop a relationship amongst them.



3.10 FURTHER READING

1) Asthana, D. K. & Meera A. (2012) *A Textbook of Environmental Studies*. New Delhi: S. Chand and Company Ltd.
2) Bharucha, E. (2004). *A Textbook of Environmental Studies.* New Delhi: UGC.
3) Kaushik, A. & Kaushik, C. P.(2006) *Perspectives in Environmental Studies.* India: New Age Publications (Academic).



3.11 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: The interaction created by the inter-relationship between the biotic and abiotic factors in the environment is called an ecosystem.

Ans to Q No 2: All the living beings living in an ecosystem are called the biotic elements.

Carbon, nitrogen, carbon, dioxide, water, carbohydrates, proteins, lipids, nucleic acid, climate, light, temperature, air etc. are abiotic factors.

Ans to Q No 3: The process of eating and being eaten among animals in any trophic structure helps the food energy to flow in a disciplined manner. This is called food chain. Food chains are of two types

(a) Grassland food chain

(b) Detritus food chain

Ans to Q No 4: The food-related relationship among different beings in a biotic community is called food web or food cycle.

Ans to Q No 5: Heat energy is directed by the two laws of thermo-dynamics. The first law is that – energy can neither be created nor be destroyed; it can only be transformed from one state to another. The second law states that during transformation, some amount of energy is lost.

Ans to Q No 6: An English scientist named Charles Elton.

Ans to Q No 7: There are three types of ecosystems in the environment –

(i) Terrestrial ecosystem (ii) Freshwater ecosystem, and

(iii) Marine ecosystem.

Ans to Q No 8: Its temperature is high (23^0 – 27^0 C)

- Every year, there is 200 – 1000 cm rainfall.
- Warm and moist climate
- Contains sufficient amount of mineral and humus.
- The height of plants differs according to species. Some trees grow upto 30-40 metres in height
- Trees which can grow under the shadow of these big trees are bamboo, ferns and shrubs etc.

Ans to Q No 9: India's Thar desert.

Ans to Q No 10: Spyrogyra, Eugonium, Zygnema Azola, Wolpaia, Salvinia, Pigtia Lemona, Echomia, Cerataphylum, Articularia, Hydrilla,

Vallisnaria, Nelumb, Typha, Saggitaria, Frogomytes, Ciliates and Flagellate protozoa, Rotifers, Daphnia, Cyclops, haylly, dragonfly, damal fly, water boatman, beetles, water insects, fish, frogs, turtles, snakes etc. and those that live in the depths like hydra; prawns, crabs, different varieties of snails.



3.12 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. What are the different types of ecosystems?

Q 2. Write the names of the elements of an ecosystem.

Q 3. Define trophic structure.

Q 4. What is food chain?

Q 5. What is the significance of food web?

Q 6. Write the names of primary producers and secondary producers.

Q 7. Write the names of the forest biomass?

Q 8. Where in India can we find tropical rainforests?

Q 9. What are the different types of ecological pyramid?

SHORT ANSWER QUESTIONS

Q 1. What are the different characteristics of aquatic biome?

Q 2. What is the role of the biotic and abiotic factors in the ecosystem?

Q 3. What is the difference between food chain and food web?

Q 4. Why does energy always flow in one direction?

Q 5. Explain one pyramid of biomass.

LONG ANSWER QUESTIONS

Q 1. Describe a pond ecosystem as an ideal ecosystem.

Q 2. What is biome? Describe tropical rainforests and grassland biome.

Q 3. What is ecological pyramid? Describe the various ecological pyramids found in an ecosystem.

Q 4. Write the characteristics of food chain. Describe two kinds of food chain with examples.

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UNIT 4 : BIODIVERSITY AND ITS CONSERVATION

UNIT STRUCTURE

4.1 Learning objectives
4.2 Introduction
4.3 Definition of Biodiversity
4.4 Values of Biodiversity
4.5 Biodiversity at global, national and local levels
4.6 Hotspots of Biodiversity
4.7 Endangered and Endemic species
4.8 Threats to Biodiversity
4.9 Conservation of Biodiversity
4.10 Let us sum up
4.11 Further Reading
4.12 Answers to check your progress
4.13 Possible Questions

4.1 LEARNING OBJECTIVES

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

- learn about the concept of biodiversity
- acquqint yourself with the ecological and economical values of biodiversity
- know about the hotspots of biodiversity with reference to Indian subcontinent
- learn about the threats to biodiversity
- know about the common endangered and endemic species of the Indian subcontinent
- know about the biodiversity conservation strategies.

4.2 INTRODUCTION

This unit provides an outlook on the concept and conservation of biodiversity. The learner will learn here the pros and cons of biodiversity at

global, national and local levels and their inherent values. The discussion begins with the definition of biodiversity. Threats to biodiversity at the local and global levels are also an important point of discussion in the unit. The concept of hotpost biodiversity as popurarised by the British naturalist Norman Myes is sought to be explained in order to make the learners acquainted with this new idea. Besides, threat to endangered and endemic species due to human intervation of their habitats calls for a detailed discussion as a part of this unit on biodiversity. Finally, conservation measures of biodiversity at all levels demand a special mention for our understanding of biodiversity.

4.3 DEFINITION OF BIODIVERSITY

Earth, the lone living planet of the universe harbours a great variety of life. These diverse living entities ,which include plants, animals and microorganisms, occurring in varied environment, have been supporting the growth and development of human civilization since its inception. Out of 7000 different kinds of domesticated plants that have been used by the human as food, only about 20 species supply 90 percent of the world's total food requirement. Domestication is an age-old practice of human civilization. Wild species with different genetic make-up still have the potential to play a prominent role in world food security and make substantial contribution to the development of medicine and industry. This information depicts the importance of biological diversity for better health care and industrial growth. This knowledge has been helping in planning sustainable livelihood and conserving natural resources in the growing world.

Biological diversity does not mean the assemblage of plant and animal species in any man made biological parks or agricultural field. Biodiversity is the total variability within all the living organisms and ecological complexes where it exists. In other words, biodiversity may be defined as an inherent quality of all living organisms occurring in any area or ecosystem. Biodiversity too is absolutely essential for stability of the concerned ecosystem and proper maintaining of the food chain or food web therein. UNESCO (1994) defined

biodiversity as “an umbrella term for variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part”.

Biodiversity is conceived at various levels, but the commonest are at genetic, species and ecosystem levels.

- **Genetic Diversity:** Genetic diversity refers to the variation of genes within a species of any plants, animals and microorganisms. Each variety within a species is the repository of unique genetic information, and the diversity of genes within the species increases its ability to adapt pollution, diseases and other changes in the environment. With the loss of any varieties and populations of a species, genetic diversity within the species is diminished resulting in the loss of ‘gene pool’ that exists within that species. With the help of modern biotechnological tools, the genetic information present in some wild animals could be made use of for the improvement of the charactristis traits of the species. Such genetic information is used for the nececery medical knowledge required for preparing medicines and also for the production of industrial goods.
- **Species Diversity:** Species diversity refers to the variety of species within a region that could be measured on the basis of the number of species occurring in the region. It is considered one of the basic taxonomic units of the biological world. The diversity is seen both in natural and man- made (agricultural) ecosystems. Natural vegetation patches have much greater species richness than that of agricultural or silvicultural patches. Species richness is also high in tropics than in temperate biomes.
- **Ecosystem Diversity:** The Earth itself is a great ecosystem within which there exists different landforms or landscapes. Each landform constitutes one unique ecosystem that supports varied and specific type of vegetation, resulting to in large variety of ecosystems on our planet. All these varied ecosystems are the important sources of biodiversity of the region. Ecosystem diversity thus could be best understood as a specific geographical region having distinctive vegetation formation and land mass formation including aquatic bodies.

4.4 VALUES OF BIODIVERSITY

We are aware of the immense potentials of the biodiversity existing on the Earth. The biological resources not only provide us nourishment, clothing, housing, fuel and medicine but also meet our several other requirements. Biodiversity is also essential for maintaining ecological processes starting from food preparation to soil formation and from watershed management to climate change. It is considered a socio-economic and monetary asset of a nation. The knowledge of biodiversity is, thus, of immense value in planning sustainable livelihood and conserving nature and natural resources. Values related to biodiversity can be grouped into *direct values* and *indirect values*. Direct values are assigned to the products harvested by the beneficiary people, and the indirect values are assigned to the benefits obtaining from biodiversity without harvesting and destroying the resources.

- **Consumptive Use Value:** Direct utilization of biological diversity or wealth as food, fodder, fuel wood, timber, medicine and game by the local beneficiary peoples come under this category. Consumptive value is related to natural biological products that are collected and consumed directly by the local communities and they do not figure in trade and market. Forest dwellers and fisher folks are completely dependent on biological resources for their sustenance.
- **Productive Use Value:** This is assigned to the products that are harvested or collected from the wild to be sold in markets at local, national and international levels. This value of biological wealth is linked with national income. Biodiversity provides us commercial products like fuel, fish, food supplements, fruits, fodder, skin, fur, wool, fiber, cereals, medicinal plants and many more. Conservation of biodiversity is, therefore, necessitated for further growth of industry and commerce.
- **Social Value:** Traditional societies are always closly associated with and depended on biodiversity. Cultural diversity is linked up with biodiversity and cultural values of biodiversity have been recognized in religion, art and literature from the earliest days of the recorded history.

One cannot ignore the social value of betel-nut (tamul) among the traditional societies of Assam.

- **Ethical Value:** Sacred groves are the ramnant patches of the old groves of forests preserved by the indigenous tribes as a part of their age-old culture and religious beliefs. These are almost intact forest communities. They provide the refuge for a large number of endemic and rare plants and animals of the region. Thus, locally protected forest patches harbour a good number of medicinal and other plants of economic importance. In other words, one can say that the sacred groves of the temple forests have been acting as gene banks for wild plants in natural environment.
- **Aesthetic Value:** Biodiversity is one of the beautiful and wonderful aspects of nature. From imagination to creativity, and from aesthetic to ethics, biodiversity attracts people for its inherent value and beauty. Aesthetic values such as the taste of wild fruits and sweet fragrance of wild flowers compel people to think about them. Recreation and eco-tourism is now an emerging trend due to this value of landscape biodiversity.

  All the native species constitute the genetic reservoir. This has the potential to provide an economic benefit to mankind at some point in the near or remote future. Studies are going on to assess the bioprospecting potential of different plants and microbes to tackle pollution and to fight with cancer, AIDS etc. with the use of the inherent genetic characteristics therein.
- **Existence Value:** This value is assigned to protect the biodiversity of an area. People offer moneytary contribution for conservation such rare animals as rhino, golden langur and migratory birds. Becouse these are also a source of income for the recreation and tourism industry of the nation. Government too spend money on the conservation the total biodiversity along with landscapes and the wild animals.

4.5 BIODIVERSITY AT A GLOBAL, NATIONAL AND LOCAL LEVELS

It has been estimated that more than 50 million species of plants, animals and microorganisms exist in the world. Out of these, the scientists have so far documented about 1.8 million organisms. Data so far available indicate that only a small fraction of the organisms is known as yet. Scientists are also aware of the immense potential of biological wealth of the Earth and they consider it a 'global resource'. The social, ethical, economic and cultural values of this biological wealth have also been recognized by the modern civilization. Different species along with their unique genetic make-up have made substantial contribution to the development of agriculture, medicine, industry, as well as to the stabilization of climate, protection of watershed, protection of soil and the protection of breeding and roaming grounds at the global level.

Each geographical region is characterized by its own biodiversity depending mainly on its climate. The species occurring in the tropical forests potentially contain cures to many diseases that afflict the modern world. India, with a very wide range of climate and habitat types have harboured about 48,000 species of plants which represent almost 11 percent of the total world flora and 81,000 animal species representing 6.4 percent of the world's fauna. One estimate says that the Indian subcontinent ,which is also know as 'Hindustan Centre' of origin and diversity of crop plants, is the centre of the origin of atleast 167 species of agri-horticultural crops. The Indian subcontinent is rich in germplasm reserve too having around 34,000 cultivars of cereals, 27 breeds of cattle and eight indigenous breeds of buffalos. Like India, Brazil, Malaysia and Indonesia are also rich in biodiversity. These biologically rich areas of the contemporary world have been attracting appreciation for the unimaginable value that exists with their biodiversity.

Assam is one of the largest states of the North east India and is characterized by distinct habitats, landscapes, broad valleys and hills. The forest types are mostly tropical and sub-tropical, which harbour one of the richest biodiversity. An estimate says that the state flora alone comprise

3017 species. Assam is also the abode of some rare species of wild animals and birds like one horned rhinoceros, pygmy hog, golden langur, hollock gibbon, white winged wood duck, adjutant stroke and many more. With its rare variety of biological wealth along with distinctive habitat types, Assam contributes a lot to the global status of biodiversity.

4.6 HOTSPOTS OF BIODIVERSITY

Life on our planet Earth is now faceing an acute crisis. Limitless consumption of the natural recources in the modern world and increasing poverty have contributed to the destruction of these resources. As a result, biodiversity has been exposed to a severe threat. Extinction is the gravest aspect of the biodiversity crisis. Though extinction is a natural process, human action have accelerated the rate of extinction many times over the natural rate. In the world today efforts are on to preseve the valuable specis , but the budgets required for this are insufficient in relation to the number of species threatened with extinction. So, identification of the conservation priorities has become very crucial. In this regard one question may come to our mind as to the biodiversity of which area of the world call for conservation.

To address the this crisis, one British ecologist Norman Myers introduced the 'Biodiversity Hotspots' concept in the year 1988. Biodiversity hotspots hold especially high number of endemic species, yet their combined area of the remaining habitat covers only about 2.3 percent of the Earth's surface. In 1988, Norman Myers for the first time identified ten tropical forest "hotspots" characterized both by exceptional levels of plant endemism and by serious levels of habitat loss. To qualify as a hotspot, a region must meet two strict criteria: it must contain atleast 1,500 species of vascular plants (> 0.5 percent of the world's total) as endemics, and it has to have lost atleast 70 percent of its original habitat.

Hotspot analysis is in constant evolution i.e. hotspots may change over time. Recently Myers identified altogether 34 biodiversity hotspots covering the entire globe. Over 50 percent of the world's plant species and 42 percent of all terrestrial species are endemic to these 34- biodiversity hotspots.

India with rich biodiversity has now become a part of *three* biodiversity hotspots: the *Himalaya*, the *Indo-Burma* and the *Western Ghats and Sri Lanka*.

- **The Himalaya Hotspot:** The Himalaya Hotspot is the home to the world's highest mountain range having a diversity of ecosystem ranging from grasslands, subtropical broad leaf forest to alpine meadows. This hotspot is the home to 3160 endemic plant species, 8 endemic threatened birds and 4 endemic threatened mammals.
- **Indo Burma:** Indo-Burma with its immense biological treasure has covered more than 12 million km^2 of tropical Asia. A wide variety of distinctive, localized vegetation formation including low land floodplain, swamps, mangroves and seasonally inundated grasslands is represented in this hotspot. Indo-Burma hotspot holds remarkable endemism in plants with 7000 species, threatened mammals with 25 species and threatened birds with 18 species. This hotspot is the home to a good number of freshwater turtle species.
  - *Western Ghats and Sri Lanka:* The remaining forests of the Western Ghats of southwestern India and the highland of southwestern Sri Lanka, which are similar in their geology, climate and evolutionary history, have been heavily fragmented due to tremendous population pressure. This hotspot region houses 3049 species of endemic plant, 10 species of threatened birds and 14 species of threatened mammals. Freshwater fish endemism is extremely high as well, with over 140 native species in this hotspot area.
- **North Eastern Region of India : A Bio-rich Area:** The North Eastern Region of India is rich in biodiversity. The rich biosphere in this region has been immeensily contributing to the agriculture, animal husbandry, fisheries, forestry and pharmaceutical industry. Geographically the region is situated at the confluence of two biodiversity hotspots- the Himalaya and the Indo-Burma. Stretching in an arc over 3,000 kilometers from northern Pakistan, the Himalaya hotspot extends upto northern Myanmar. It covers hills and mountains of Sikkim, Assam and Arunachal Pradesh. The Indo-Burma hotspot again begins in eastern Bangladesh and then extends across North East India and south of the Brahmaputra river up

to Vietnam and Malaysia. The Hot spot confluence is the home to the important populations of numerous birds and mammals, including vultures, tigers, elephants, rhinos and wild water buffalos. This region has been identified by ICAR as a centre of rice germplasm, while NBPGR (India) has highlighted the region as being rich in wild crops.



CHECK YOUR PROGRESS

Q1. (i) Biodiversity is an abbreviation of

a. Abiotic factors b. Biotic factors

c. Biological diversity d. Biological rhythm

.....

(ii) Genetic diversity refers to

a. Variation of genes within a species

b. Variation of genes within a genus

c. Variation of genes within a habitat

d. Variation of genes within a fruit

.....

(iii) Species diversity is high at

a. Temperate forest b. Tropical forest

c. Mountain peaks d. Highway sides

.....

(iv) 'Biodiversity Hotspot' concept is put forward by

a. Darwin b. Fleming c. Myers d. De Vries

.....

(v) North eastern Region is situated at the confluence of two biodiversity hotspots

a. Himalaya and Andaman b. Himalaya and Indo-Burma

c. Himalaya and Bangladesh

d. Himalaya and Bay of Bengal

.....



Speciation : Formation of new and distinct species in the course of evolution.

4.7 ENDANGERED AND ENDEMIC SPECIES

- **Endangered Species:** ***Speciation*** and extinction are two inevitable

natural processes. Though extinction is the ultimate fate of a species in the struggle for survival, habitat loss mainly due to human intervention does expedite the process of extinction. Since 1600, the world has lost about 62 mammals, 117 birds and 596 plant species due to human interference. Considering the relative importance of threat to species extinction, IUCN has categorized *six* major groups of threatened species in the *Red Data Book*: *extinct, endangered, vulnerable, rare, indeterminate and less know.*

The *endangered* species are those that are in danger of extinction if the current causal factors continue to operate. The population size of these species has been reduced to almost 50 % over the last 10 years. The prime factors for the rapid decline in number of the species are loss of habitats and breeding grounds, harvesting and hunting, predation, disease, climate change etc.

According to the Indian Red Data Book published by Botanical Survey of India, ten per cent of the total flowering plants in the country are endangered. Out of 1500 endangered flowering plants, 800 are reported from North East India. As per IUCN Red Data Book about 12 out of 19 primates and about 28 out of 36 carnivores of India are endangered.

Some endangered species of North Eastern Region are given below:

Plants	**Animals**
Arundia graminifolia	*Rhinoceros unicornis*
Dipteris wallichii	*Hylobates hoolock*
Dendrobium aurantiacum	*Presbytis geei*
Dendrobium hispida	*Cervus unicolor*
Brainae insignis	*Panthera tigris*
Livistonia Jenkinsiana	*Elephus maximus*
Clematis apiculata	*Cairina scutulata*
Ophiorrhiza hispida	*Eupodotis bengalensis*

- **Endemic Species:** Endemism means the confinement of a particular species to a particular geographical location. It means that it is found

only in that part of the world and nowhere else, and such species are known as 'endemic species'. Endemic species can easily become endangered or extinct because of their restricted habitat and the actions of men. The factors responsible for endemism are: geographical barriers and poor adaptability of the species to a wide range of environment. The NER alone have 1,500 endemic plant species.

Given below is a list of some endemic plants of Assam:

Mesua assamica	*Camellia sinensis*
Aquilaria agalocha	*Dipterocarpous manii*
Impatiens manii	*Ixora goalparensis*
Maba cacharensis	*Derris cuneifolia*

4.8 THREATS TO BIODIVERSITY

Human activities are the major threat to biodiversity. Man is responsible for the deforesting of natural patches and the grasslands resulting in the loss of thousands of valued species along with their habitats. With the explosive growth of human population, the requirement for food, fodder, fuel and fibre has increased manifolds which has put great stress on the natural wealth. Overexploitation of natural resources, habitat loss and pollution are contributing to a greater extent towards the rapid degradation of environment quality along with irreversible loss of biodiversity.

- **Habitat Loss:** The primary cause of loss of biodiversity is the habitat destruction. No habitat-no life. Explosion of human population and expansion of human activities are responsible for the habitat destruction. As a consequence of this, the native species must either adopt to changes or move elsewhere or succumb to ***predation***, starvation and disease and eventually die. Habitat fragmentation may limit the potential of the species for dispersal and colonization. Fragmented forest patches have now become hurdles threatering the survivality of the Hollock Gibbon community in upper Assam. Bengal Florican and Pygmy Hog are again on the verge of extinction due to habitat destruction in Assam. Construction and expansion of roads, extenssion of agriculture and



Predation : The preying of one animal on an other.

industrial firms have drastically affected the density and abundance of Pitcher plant (*Nephenthes khasiana*) in Meghalaya.

- **Poaching of Wildlife:** The wild animals are being killed for their products like hides and skins, tusks, fur, meat, medicine and perfumes etc. Assam rhino is now on the verge of extinction due to poaching for its horn. In Africa and Canada, excessive killings of rhinos and elephants in the last century have resulted in the extinction of these species in their native ranges. In Assam too, the elephant is hunted for its ivory and meat; cats are killed for their skins and bones, dolphins for meat and fat, migratory and some resident birds for feathers and meat, and snakes and lizards for their skin. Several species of the wild ***ungulates*** thus have been endangered by their demand in national and international trade. Being the signatory of CITES (Convention on International Trade in Endangered Species), India is now working for the protection of species at national, as well as international level. CITES regulations have reduced illegal international trading to a great extent. But, poaching is still continuing in the bio- rich zones at local level.



Ungulate: a mammal that has hoofs.

- **Biopiracy:** Biopiracy is a kind of procurement of biological resources from a country or place and the subsequent patentisation of their products. Indigenous societies of the developing and underdeveloped countries are the repository of traditional knowledge and beliefs. Scientists and some times the industry people of some developed regions of the world unethically collect living life materials and information on them from the local people of the countries rich in biodiversities and subsequently proceed for patent documentation claiming that the products are the information on their own. Thus through false advertisement they acquire the rights of marketing these products. 'Turmeric' and 'Basmati rice' which have been used by Indian societies over centuries have been accorded the US patent. These are some clear cases of 'biopiracy'. The Government of India should challenge against these countries for such unethical patent right indulged in by them.

- **Man-Animal Conflict:** Man-animal interactions have always had profound consequences on their very existence. With the shrinkage and destruction of the natural habitat, this interaction has taken an ugly turn. This leads to conflict between the lwo resulting in loss to human and wildlife. Man-animal conflict has now become a sensitive issue overwhelming in its magnitude and complexity. Population explosion, expansion of human habitation, expansion of agriculture and industries, extraction of timber and non timber forest resources are the root causes behind the increasing cases of conflict between wild animals and human beings.

  For example, the infiltration of leopards the Guwahati city has also been rising with the expansion of the city since 1990. The incidence of human-elephant conflict again has been on the rise in Assam. More than 40 people on an average have lost their lives to elephants every year in Assam. It has been reported that more than a hundred people and over 90 elephants have lost their lives in the last decade in the Sonitpur District of Assam alone.

4.9 CONSERVATION OF BIODIVERSITY

Conservation of biodiversity is the rational management of the biological wealth along with its interacting ecological systems for the benefit of all lives including humankind, in the entire biosphere. It has to be so managed that it may yield sustainable benefit not only to the present generation, but may also meet the needs and aspirations of the future generations. A few ethical arguments behind the conservation concept are: each species has a right to exist; it renders specific ecological service to mankind irrespective of its size; the loss of the species may have far reaching consequences for nature.

Conservation of biodiversity is of two types:

- **In-situ** conservation
- **Ex-situ** conservation

- **In-situ Conservation:** The conservation of biological diversity along with its habitat and ecosystem where they naturally occur is called *in-*

situ conservation, i.e. on site preservation. It is one of the advantageous and feasible methods to conserve natural biodiversity of a geographical area. 'The Protected Area' concept has been suggested for *in-situ* conservation of the threatened plant and animal species. The IUCN (1985) has categorized eight different types of protected areas with distinct management objectives. These are : the scientific reserves/ strict nature reserves, national parks, national monuments/landmark, managed nature reserve/wildlife sanctuary, protected landscapes, resource reserve, natural biotic area/anthropological reserve and multiple- use management areas.

At the initiative of Government and some non Governmental Organizations, Assam now has 5 National Parks, and 22 Wildlife Sanctuaries. The Kaziranga National Park and the Pobitora Wildlife Sanctuary are protecting the remaining population of the Asiatic Rhino. The wet alluvial savannah grassland habitat of Kaziranga is also the home of large herds of swamp deer, hog deer, elephants and birds like- Bengal Florican. The Pobitora Wildlife Sanctuary offers a wonderful opportunity to observe rhinos from elephant back. The Manas National Park, which is also declared as 'Biosphere Reserve', is the home for rare Golden Langur and Pygmy Hog.

- **Ex-situ Conservation:** Ex-suit conservation is the conservation of vulnerable species outside its natural habitat in a carefully managed and controlled situation such as botanical garden for plants and zoo or zoological park for the animals. These gardens and parks are artificially managed to allow the species to multiply. Preservation of germplasm of any species in a gene bank is also an experimental situation in monitored conditioned. Though expensive, gene banks provide an excellent opportunity to preserve genetic diversity, so that it can be used, if needed, in future breeding programmes. In Assam, successful ex-situ conservation programmes have been undertaken for Pygmy Hog, the smallest wild bore of the world at Basistha, Guwahati.



CHECK YOUR PROGRESS

Q 2. State whether the following statements are true (T) or false (F)

(i) Rhino is found in Nagaland.

.....

(ii) White winged wood duck is the state bird of Assam.

.....

(iii) *Aquilaria agalocha* is endemic to Assam.

.....

(iv) Pygmy hog is a migratory animal.

.....

(v) Zoo is the example of *ex-situ* facilities.

.....

(vi) Gene banks provide an opportunity to preserve genetic diversity.

.....



4.10 LET US SUM UP

- Biodiversity refers to the variability among the living organisms.
- Biodiversity concept can be subdivided into three levels- genetic diversity, species diversity, and ecosystem diversity.
- The knowledge of biodiversity is of immense utility in planning sustainable livelihood and conserving natural resources as a whole.
- Each species has value of its own in nature.
- The loss of biodiversity may have far reaching consequences for nature.
- Biodiversity is a valuable resource that should not be wasted.
- Loss of biodiversity means the extinction of species and erosion in gene pool.
- Human activity is the major threat to biodiversity.

- People should take responsibility for conserving biodiversity.
- Attempts have already been made to identify the areas of the world that have rich biodiversity and high level of endemism and are facing immediate threat of species extinction and habitat destruction.
- Biodiversity with intact ecosystem can be preserved *in-situ* by taking adequate measures to cover the under protected area network.
- Protected areas like Natural parks and Sanctuaries have been created to protect the highly endangered species of wild plants and animals in their homeland itself.
- Botanical gardens, Zoological parks and Gene banks are a few measures of *ex-situ* conservation.



4.11 FURTHER READING

1) Asthana, D. K. & Meera A. (2012) *A Textbook of Environmental Studies*. New Delhi: S. Chand and Company Ltd.
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6) Kaushik, A. & Kaushik, C. P.(2006) *Perspectives in Environmental Studies.* India: New Age Publications (Academic).

4.12 ANSWER TO CHECK YOUR PROGRESS

Ans to Q No 1: (i) c (ii) a (iii) b (iv) c (v) b

Ans to Q No 2: ((i) False (ii) True (iii) True (iv) False (v) True (vi) True

4.13 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. What is biodiversity?

Q 2. What are the causes of the extinction of biodiversity?

SHORT ANSWER QUESTIONS

Q 1. What are the consumptive and non-consumptive values of biodiversity?

Q 2. Write short notes on

a. National Parks of Assam

b. Endemic species

c. Biodiversity hotspots and North Eastern Region of India

LONG ANSWER QUESTIONS

Q 1. Explain the various threats to biodiversity and the mode as for its conservation.

Q 2. Why should we conserve biodiversity?

Q 3. Write a note on man-animal conflicts of Assam.

*** **** ***

UNIT 5 : ENVIRONMENTAL POLLUTION

UNIT STRUCTURE

5.1 Learning Objectives

5.2 Introduction

5.3 Environmental Pollution-definition

5.4 Air Pollution

5.5 Water Pollution

5.6 Soil Pollution

5.7 Noise Pollution

5.8 Thermal Pollution

5.9 Role of Individual in Prevention of Pollution

5.10 Let Us Sum Up

5.11 Further reading

5.12 Answers to Check Your Progress

5.13 Possible Questions

5.1 LEARNING OBJECTIVES

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

- define environmental pollution
- classify the different forms environmental pollution like air, water, soil, noise and thermal pollution
- identify the various sources of environmental pollution
- list the pollutants causing pollution to the environment
- describe the effects of different forms of pollution on men, animals, and vegetation and on physical structures like historical monuments
- explain the different pollution control measures.

5.2 INTRODUCTION

Environmental pollution has become a major concern today. You have heard very frequently about the global warming, climate change, melting of ice in the poles, extinction of some species etc. All these are due to

environmental pollution caused mainly by human activities. In this unit we shall discuss environmental pollution, the causes and sources of various forms of pollution, its effects on human and other organisms. Also, some preventive measures for pollution control will be discussed. Thus, this unit will give you a comprehensive idea about environmental pollution.

5.3 ENVIRONMENTAL POLLUTION-DEFINITION

An undesirable change in the physical, chemical, or biological characteristics of the natural environment brought about by man's activities may be termed as environmental pollution. Such a change may be harmful to human and the environment. Pollution may affect all kinds of essential substances for man like soil, water and air etc.

5.4 AIR POLLUTION

Air pollution is the contamination of air by the addition of some harmful substances. Air pollution can cause damage to all plants, animals and men as well as the entire habitat.

- **Sources of Air Pollution:** Air pollution occurs mainly from two types of sources. These are:
  - Natural sources
  - Manmade sources
  - *Natural sources:* The natural sources include many natural environmental events like forest fire ,volcanic eruption ,soil erosion, landslide, loss of biomass and radiation etc. These contribute to air pollution.
  - *Manmade sources:* Manmade sources include the various kinds of human activities which cause air pollution. These sources are:
    - Industrialization: With increasing urbanization the rate of industrialization is also rising each day. The smoke emitted from the chimneys of the industries contain huge amount of CO, CO_2, SO_2, H_2S etc. Especially coal, petroleum industries and thermal plants emit these gases in high amount. Many chemical

industries also release high amount of HCl, CL,$N_2$0, Zn,As,Cu_2O,H_2S etc. and thereby cause air pollution.

- Combustion of fuels: The combustion of coal and petrol generates high amount of CO_2 in the air and if the combustion is incomplete then it releases CO, CH_4 and many other hydrocarbons. These gases contribute to air pollution.
- Vehicular Traffic: With the increase of vehicular traffic the amount of combustion of petroleum also increases and the emission of high amount of smoke from the vehicles containing CO, CO_2, and SO_2 penetrates into air, water, soil and settles on the food chain. This causes severe air pollution.
- Explosion: Explosion occurs on account of wars that take place between two or more countries and also for various nuclear research activities. As a consequence, high amount of toxic radioactive substances are mixed with the air and thereby cause air pollution.
- Agricultural Activities: The use of pesticides for agricultural activities starting from fungicide to herbicides which are composed of highly toxic chemicals like phosphate, chlorinated hydrocarbon and, arsenic and lead. These are mixed with the air and cause damage to the environment. Besides, the clearing of forests and grasslands for agriculture produces about 60%-65% of CO_2 that causes air pollution.
- Suspended Particulate Matter (SPM): These types of pollutants mainly include pollens, germs, bacteria, viruses ,aerosols and small particulates which are released by the splintering of rocks.

- **Air Pollutants - Their Types:** The air pollutants may be divided into two groups:
  - *Primary pollutants :* Primary pollutants are those substances which enter into the air without any physical and chemical change and pollute the air. Examples of this type of pollutant are - CO, NO, SO_2 VOCs and suspended particulate matter (SPM).

- *Secondary Pollutants :*These are produced from the various types of interactions among the primary pollutants in the atmosphere e.g. ground level ozone, Chlorofluorocarbons (CFC) etc.

- **Effect of Air Pollution on Animals:** Air pollutants affect the health of the animals in various ways. These are described below-
  - Carbon dioxide enters in the blood stream through lungs and produces carboxyheamoglobin. As a consequence, the oxygen carrying capacity of blood is reduced.
  - NO_2 causes various respiratory diseases besides producing acid rain in the environment .Absorption of this chemical causes eye irritation, oedema etc.
  - SO_2 increases the possibility of the incidence of some diseases like asthma, bronchitis etc.
  - Benzene is known as a main cause of Cancer. The temporary elements may cause irritation to eyes, nose and throat.
  - Some smoky substances (aerosols) may cause breathing problems for a long time besides producing skin, throat and nose irritation as allergens.
  - Lead damages the liver, the nervous system and the reproductive system. It also causes anemia, neurological problem, eccentric behaviour and high blood pressure.
  - Due to the toxicity of mercury and cadmium the central nervous system, liver, heart and fetus get damaged.



Lichens : moss; a simple composite plants consisting of a fungus typically growing on rocks, wall and tree.

- **Air Pollution and its Effects on Plants:**
  - Because of the absorption of hydrocarbon, the leaves of trees become yellowish and along with the fruits fall off in an immature stage.
  - ***Lichens*** are very sensitive to pollution and these are a pollution indicator.
  - Ozone destroys the chlorenchima in plants and thereby causes the rotting of a plant.
  - Fluoride causes necrosis of the side and front portion of the tree leaves and helps in the rotting and falling of the leaves.

- **Air Pollution and its Effects on Climate:**
  - *Greenhouse Effect and Global Warming :* The radiation from the sun controls the earth's weather and climate and after heating the earth's surface the remaining amount is radiated back into the space. The atmospheric greenhouse gases (water vapour, carbon dioxide and other gases) trap some of the outgoing energy, retaining the heat somewhat like the glass panels of a glasshouse. These gases are called green house gas and the phenomenon is known as "greenhouse effect." However, the problem arises when atmospheric concentration of greenhouse gases increases .Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide and CFS has increased 50% and 20% respectively. These increases have enhanced the heat-trapping capability of the earth's atmosphere resulting in global warming and change in climate.
  - *The negative aspects of global warming :*
    - Glaciers in the poles will melt by the end of this century and the sea level will rise upto 1-3 meters. As a consequence, the cities in the coastal areas like Mumbai, Chennai, Kolkata, London, New York, Shanghai, Dhaka, Venice will be submerged. Many island nations like Maldive, West Indies etc. and Southern part of Bangladesh, Coastal areas of India will be drowned.
    - Production of crops will be highly affected.
    - Forests, national parks will be affected and loss of biodiversity will be noticed.
    - Intensity and frequency of the occurrence of cyclones, tsunami in the sea shore area will increase.
    - The Indian Monsoon system will be affected which in turn will affect major crops like rice and wheat.
- **Control of Air Pollution:** It is to be noted that once the air gets polluted, it is almost impossible to purify it. The best way to control air pollution is to prevent the pollutants at source from being mixed up with air. This involves the following strategies:

- All those fuels used in vehicles should be free from sulfur and lead. It can reduce air pollution upto 50%.
- The height of the chimneys in the industries should be increased.
- When smokes emitted from the chimneys are allowed to pass through a filter or a small metalic room some amount of pollutants are absorbed in the walls and the rate of pollution is decreased.
- Rate of afforestation should be increased.
- The sources of incombustible energy should be found.



CHECK YOUR PROGRESS

Q 1. What are the main sources of air pollution?

.....

Q 2. What are the major air pollutants?

.....

Q 3. What are the greenhouse gases?

.....

5.5 WATER POLLUTION

When the biotic and abiotic substances are mixed into water and bring about physical, chemical and biotic changes into it then the water becomes impure. This is called water pollution, which causes harm to human health.

- **Causes of Water Pollution:** Water pollution spans a wide range of chemical, physical and microbial factors. The major causes of water pollution are the raw sewage, garbage, fertilizers and pesticides used in agriculture, oil spills and wastes from industrial units. Sewage and fertilizers bring in nutrients to the water bodies. In excess levels, nutrients overstimulate the growth of aquatic plants and algae causing eutrophication. Excess growth of these types of harmful plants consequently clog the waterways, use up dissolved oxygen as they decompose and block penetration of light into the deeper level of water. This in turn proves very harmful to the aquatic organisms.

- **Major Water Pollutants-their Sources and effects:** The sources can be categorized as –
  - Effluents from industries
  - Excessive heat
  - Agricultural activities
  - Domestic wastes
  - *Effluents from industries:* The effluents from the chemical industries carry high amount of various heavy metals, mercury, lead, copper, arsenic, cadmium which are highly toxic .When these are disposed in the water bodies, the quality of the entire aquatic system is affected and environment is polluted.

    Effects of industrial wastes:
    - Nitrates(more than 90 ppm) from the industrial wastes cause "Blue baby syndrome" disease .
    - Hg,As,Pb cause damage to the central nervous system.
    - When the mercury-toxicated fishes in the Minamata bay of Japan were eaten by people they suffered from the disease called 'Minamata disease".
    - The fibers of asbestos cause a form of Lung cancer known as Asbestosis.
    - Cadmium causes lung cancer and bone deformation.
    - Excessive nitrate causes methamoglobenamea.
  - *Excessive heat:* Due to certain human activities, rising of water temperature is very common. High amount of heated water from is thermal plants and nuclear plants is released to the nearby water bodies as wastes as a result of which the water bodies get heated and the aquatic organisms there like fish and plants are severely affected.
  - *Agricultural activities:* The pesticides and chemical fertilizers used in the agricultural fields flow to streams thereby polluting the entire water system. P.C.B, D.D.T types of chemicals found in the bones of organisms and even in the endocrine gland do not decompose

and consequently cause serious damage to the organs. The increase of nitrates causes algal bloom in the water body for which the aquatic system is degraded.

- *Domestic wastes:* The organic decomposition of human, animal and domestic wastes, garbage, soap, detergent,bacteria and viruses etc are mixed with water and the whole system is polluted .
  - The domestic sewage drains supply high amount of algae, fungi, virus ,bacteria which are the root cause of certain diseases like cholera, jaundice etc.
  - Phosphate in the detergents causes the increase of algal blooms.

- **Control of Water Pollution:**
  - It is possible to control water pollution at the point of generation in the plant. Water cooling pond, tower may help in this regard.
  - The waste water can be reused by applying some chemical techniques. Soda, bleaching powder can be used for cleaning the water used for domestic purposes.
  - Toxic and dirty water from drains and canals should be prevented from being released into the water bodies.
  - Instead of using chemical pesticide, people should be encouraged to use herbal ones which do not have side effects.

5.6 SOIL POLLUTION

The fertility of soil decreases owing to the addition of some toxic elements into it**.** This leads to the pollution of the environment and it is called soil pollution.

- **Sources of Soil Pollution:**
  - *Domestic wastes:* All household wastes that include kitchen wastes, broken bottles, plastic, polythene bags and miscellaneous waste materials when indiscriminately thrown into the land cause the gradual loss of fertility of the soil.

- *Industrial wastes:* Industrial wastes are basically the effluents released by industries. These effluents cause the pollution of the soil. Some industries and their pollutants are mentioned below.

Industries	*pollutants*
Oil industry	Unrefined oil, hydrocarbons
Plastic industry	Dioxine
Refinery centers	potassium salt
Cloth industry	chloride ion

- *Agricultural activities:* Varieties of pesticides, fungicides, herbicides etc. cause the decrease in fertility of soil.
- *Germs:* Viruses, bacteria etc. disposed by hospitals, laboratories etc. contribute to the pollution of the soil.

- **Effects of Soil Pollution:**
  - Varieties of soil transmitting diseases like giardiasis, tetanus etc are caused by soil pollution.
  - Some metals like As,Hg,Cd etc mix with soil and toxicity occurs. When the crops are treated with these chemicals, the chemicals enter the plant body and destroy the body functions.In 1970, 200 people in Japan died due to cadmium toxicity caused by the itai-iti disease.
  - The pesticides not only decrease the fertility of the soil but also enter into the food chain and thus cause diseases.
  - The capacity of crop production of the soil is decreased gradually.
  - The excessive use of chemical pesticide destroys the natural bacteria of the soil.
- **Control of Soil Pollution:**
  - Proper action should be taken before the disposal of domestic wastes and chemical wastes into the soil.
  - Solid wastes can be segregated from the garbage dumps and can be reused by using chemical techniques.
  - High level of technology should be used to improve the agricultural production instead of using chemical pesticides.

- Afforestation will help in soil fertility.
- Microbial degradation of biodegradable substances is also one of the scientific approaches for reducing soil pollution.
- Necessary enactment of laws should be made for penal action against those who indulge in the act of polluting the soil.



CHECK YOUR PROGRESS

Q 4. What are the main causes of water pollution?

.....

Q 5. Write two major effects of water pollution?

.....

Q 6. Write one of the control measures of soil pollution.

.....

5.7 NOISE POLLUTION

Noise is a loud or unpleasant sound or series of sounds. Noise pollution is caused by such unpleasant sounds created by man, animals or machines. Such noises sometime create an unbearable situation affecting the peace and tranquility of a place. Since noise travels through air, all forms of noise are considered an air pollutant.

- **Measurement of Noise:** The intensity of sound is measured in sound pressure levels (SPL) and common unit of measurement is decibel, dB.
- **Sources of Noise:** The sources of noise may vary according to our daily activities. The sources may be
  - *Domestic* : It involves the sound created by the air conditioner, home appliances, pressure cooker, television etc.
  - *Natural :* Wind, earthquake, volcano, storm, landslide, waterfalls are the natural sources of noise.
  - *Commercial* : Various types of construction works, automobiles, aeroplanes, factories, machinery etc.

- *Industrial* : generator sets, boilers, plant operations, trolley movement, transport vehicles, pumps, motors etc..

  In Indian conditions, indiscriminate use of the public address system and diesel generator set, has given a new dimension to the noise pollution problem.

- **Effects of Noise:**
  - *Annoyance:* It creates annoyance to the receptors due to the fluctuations in the sound level. It annoys and frightens the hearer besides causing discomfort and headache to him.
  - *Physiological effects:* The increasing physiological effects include blood pressure, sleeplessness, heart-beat and acute headache.
  - *Loss of hearing:* Continuous exposure to high sound levels causes loss of hearing besides affecting the airdrum.
  - *Nervous system:* Pain in ears, feeling of tiredness, disorder of nervous system.
  - *Suicide cases:* Sleeplessness, high blood pressure, suicidal cases are also evidenced. Accidents may occur due to the trauma sleeplessness caused by noise pollution. There are instances of suicides attributed to noise pollution.
- **Control of Noise Pollution:**
  - Educational institutions,hospitals,residential areas should be declared as Silent Zones and there should be no noise pollution in those areas.
  - New techniques should be used to reduce the sounds from the heavy machines.
  - Use of radio, television in low volume.
  - Airports, industries should be established in areas away from residential places.
  - Increase of afforestation .
  - The playing of high volume speakers, microphones should banned.

    To invoke legal provisions in banning the use of loud speakers and bursting crackers at night.

5.8 THERMAL POLLUTION

Thermal pollution is a temperature change in natural water bodies caused by human influence especially by the waste water of power plants which is disposed in the lake, river or ocean .Thus, the whole aquatic system is polluted and organisms are affected. This phenomenon is known as thermal pollution

- **Effects of Thermal Pollution:** All plant and animal species that live in water are adapted to temperature within a certain range. A slight change in temperature by one or two degrees may have tremendous effect on the aquatic community leading to threats to biodiversity.
  - ➢ High temperature destroys the quality of the gastric juice. It decreases the rate of photosynthesis and thus affects the primary producers (plants).
  - ➢ Salmon and Trout fish cannot lay eggs in high temperature.
  - ➢ Rate of dissoloved oxygen in the water body is decreased by thermal pollution.
  - ➢ Decreasing reproductive capacity of fishes.
  - ➢ Increasing toxicity of chemical pesticides.
- **Control of Thermal Pollution**
  - ➢ The hot water used in power plants and industries should be routed through the cooling pond or cooling tower so that the evaporation causes the cooling of the water.
  - ➢ The cooling of water can also be done by the use of cooling tower. These cooling techniques are of two types.
    - a) Dry cooling
    - b) Wet cooling
  - ➢ Necessary awareness is to be created among people regarding the effects of thermal pollution.



CHECK YOUR PROGRESS

Q 7. How is noise pollution measured?

.....

Q 8. What are the major domestic sources of noise pollution?

.....

Q 9. State True or False

(a) High temperature causes the quality of the digestive juice.

(b) Salmon and Trout fish can lay eggs in high temperature

.....

5.9 ROLE OF INDIVIDUAL IN PREVENTION OF POLLUTION

The role of individuals in preventing pollution is very important because if every individual is conscious about the ill effects of pollution, there will be less impact of pollution. The following measures at citizen-level will help in reducing pollution:

- **Preventing Air Pollution:**
  - Use of public transport to workplace or sharing vehicles
  - Walking or cycling for relatively short distance travels
  - Economic use of electricity and fuel
  - Use of low-energy or energy saving light bulbs
  - Turning off the engine of the car when waiting.
- **Preventing Water Pollution:**
  - Reducing unnecessary water use
  - Not allowing any type of waste or dirty clothes to go to the drains
  - Removing any stagnant pool of water in the backyard
  - Ensuring hygiene and proper sanitation
  - Using biodegradable or environmentally friendly soap and other cleaning supplies
- **Preventing Soil Pollution:**
  - Using reusable containers and bags
  - Use of biodegradable materials
  - Controlling the use of hazardous chemicals such as pesticides
  - Taking precaution while disposing used goods such as radio, TV, other electronicgoods,mobiles,cameras, electrical bulbs, plastic furniture. etc.

- **Preventing Noise Pollution:**
  - Keeping the volume of musical instruments to low level when playing
  - Avoiding the unnecessary use of loud speakers at residential places.



5.10 LET US SUM UP

- An undesirable change in the physical, chemical, or biological qualities of the natural environment brought about by man's activities is termed as environmental pollution. From this unit we have learnt about all kinds of pollution and their sources, their effects and the measures to control them.
- This unit describes all kinds of health problems and loss and damage caused by the pollution of air, soil, water, noise.The major soil pollutants are domestic and industrial wastes, pesticides, petroleum hydrocarbons, plastics, heavy metals, acid rain, fly ash etc. Besides, the control measures for all these kinds of pollution have been briefly dealt with.
- Due to the increasing urbanization and industrilization, the rate of pollution is increasing day by day degrading the quality of the environmental components.Therefore each and every citizen should be aware about the harmful effects of environmental pollution and the measures to be adopted for its control.



5.11 FURTHER READING

1) Asthana, D. K. & Meera A. (2012) *A Textbook of Environmental Studies*. New Delhi: S. Chand and Company Ltd.
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5.12 ANSWER TO CHECK YOUR PROGRESS

Ans to Q No 1: i) Natural sources ii) Manmade sources

Ans to Q No 2: CO, NO_2, SO_2, VOCs, suspended particulate matter etc

Ans to Q No 3: These include CH_4,water vapour, carbon dioxide, CFCS etc.

Ans to Q No 4: a) Effluents from industries,
b) Excessive heat
c) Agricultural activities
d) Domestic wastes.

Ans to Q No 5: i) Nitrates(more than 90 ppm) from the industrial wastes cause “Blue baby syndrome” disease .
ii) Hg,As,Pb cause damage to the central nervous system.

Ans to Q No 6: i) Proper action should be taken before the disposal of domestic wastes, chemical wastes into the soil.

Ans to Q No 7: The intensity of sound is measured in sound pressure levels (SPL) and common unit of measurement is decibel, dB.

Ans to Q No 8: Domestic (movement of utensils, home appliances, pressure cooker, television, air cooler, air conditioners etc.),

Ans to Q No 9: a) true b) false



5.13 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. Define “Environmental Pollution”.

Q 2. What are the major air pollutants?.

SHORT ANSWER QUESTIONS

Q 1. What do you mean by Greenhouse Effect?

Q 2. Write notes on

(a) Noise pollution (b) Thermal pollution (c) Water pollution

LONG ANSWER QUESTIONS

Q 1. What are the major sources of water pollution? How does water pollution affect man and other animals?

Q 2. Enumerate the measures that can be adopted at citizen level to prevent air, water and noise pollution.

*** **** ***

UNIT 6: CONCEPT OF DISASTER

UNIT STRUCTURE

6.1 Learning objectives

6.2 Introduction

6.3 Defining disasters

6.4 Types of disasters

6.5 Difference between hazard, disaster, risk and vulnerability

6.6 Causes, effects and mitigation measures of some natural disasters

6.7 Manmade disasters

6.8 Let us sum up

6.9 Further reading

6.10 Answers to check your progress

6.11 Possible questions

6.1 LEARNING OBJECTIVES

After going through this unit you will be able to —

- define the concept of disasters and classify them
- learn the concept of some similar terms- hazard, disaster, disaster risk and vulnerability
- learn about the causes of some major natural disasters and the measures to mitigate them
- learn about man made disasters.

6.2 INTRODUCTION

In this unit we are going to discuss the concept of disasters and the difference that lies between disaster and some synonymous terms. You will get to know from this unit about these extreme calamities, their causes, their characteristic effects and the mitigation measures to be adopted. You may already have a fair experience of these natural or manmade hazards that commonly occur in N.E. India.

So, this unit will present to you a brief account of all these disasters and the measures to cope with them.

6.3 DEFINING DISASTER

"Disaster" is a sudden adverse and unexpected natural or manmade event which causes significant physical damage, loss of lives or property, sometimes permanent change of the natural environment. Disasters occur very rapidly, instantaneously and indiscriminately.

It is an unforeseen event which may cause great loss of lives and property and damage to the whole environment.

6.4 TYPES OF DISASTERS

It can be broadly divided into two types - Natural and Manmade or Anthropogenic.

- **Natural Disasters :** These are the results or responses to some extreme physical events which cause a significant loss of life, damage to property, and affect the whole environment.
- **Manmade Disasters :** These are the results of some extreme anthropogenic events which cause great loss or damage to life, property as well as the environment.

6.5 DIFFERENCE BETWEEN HAZARD, DISASTER, RISK AND VULNERABILITY

These four alternative terms viz Hazard, Risk, Disaster and Vulnerability, though they seem to be similar, as they all deal with the extreme events, yet these are actually different in their actual meaning and use. Let us discuss their differences below :

- **Environmental Hazard** *:* Environmental Hazard can be defined as those extreme events (anthropogenic/natural) which may cause catastrophic damage to property and loss of lives and degradation of environment. Hazards are considered the processes or the causal factors resulting from most extreme events.

- **Disasters :** Disasters are the results of these extreme events. The intensity of the environmental disaster is always measured in terms of the total damage done to human lives, property and the environment. Disasters are the results of hazards and are very rapid and instantaneous. Such events cause great damage to human society.
- **Risk :** Risk can simply be defined as the measured probability of occurrence of a hazard and its expected losses or some uncertain outcomes. It is the indicator of any kind of threat, uncertainty or negative impact. It is also written as the following—

  Risk= Probability of event occurring x impact of event occurring
- **Vulnerability :** It is the measurement of the capacity of the system to absorb and recover from any hazardous events. According to Peter Timmerman, "Vulnerability is the degree to which a system may react adversely to the occurrence of a hazardous event".



CHECK YOUR PROGRESS

Q 1. Give a definition of disaster.

.....

.....

Q 2. True or false -

a) Disasters are the responses to the hazards.

.....

b) Vulnerability is the probability of occurrence of a hazard.

.....

Q 3. Fill in the blanks -

According to Peter Timmerman, "Vulnerability is the degree to which a system may react adversely to the occurrence of a .....".

6.6 CAUSES, EFFECTS AND MITIGATION MEASURES OF SOME NATURAL DISASTERS

- **Flood Disaster:**
  - *Definition of flood :* Flood simply means "inundation of extensive

land area with water for several days in continuation."

In other words, it is that condition of a river when the amount of water it carries is much larger than its carrying capacity and as a result the water cannot remain confined to the river and inundates the nearby low areas. It may be noted that flood is a natural phenomenon. It is caused by heavy rainfall but it causes loss to human lives and property.

- *Causes of Flood:*
  - Heavy Rainfall : Continuous heavy rainfall for a long period is the main cause of flood. During heavy rainfall there is a larger accumulation of water in the upper catchment areas of the concerned river and it flows into the downstream areas, thereby causing flood in the plains below. Similarly, lower catchments areas are also affected by heavy rainfall. Assam experiences frequent flood caused by the Brahmaputra river.
  - River system blockage : Blockage of river drainage system due to landslide or encroachment also creates severe inundation in the low catchments areas.
  - Meandering river course : Sinuous and meandering river courses obstruct the normal flow system and reduces the velocity resulting in stagnation of water for prolonged periods which ultimately leads to the overflow of the surrounding areas.
  - Low rainfall areas : Sudden heavy rainfall in the arid and semi arid areas where rainfall is scanty and infrequent also causes flash floods as such areas have very poor drainage system.
  - Deforestation : Injudicious and indiscriminate destruction of forest resources in the upper catchment areas decreases the infiltration capacity of the soil and consequently increases the surface runoff resulting in severe flood.
  - Urbanization : Increasing urbanization increases the intensity and magnitude of floods. Construction of buildings, roads etc. reduces infiltration of water and considerably increases the surface runoff of water. This causes floods in the urban areas.

- ❍ Decay of Dams/Embankments : Due to natural and man-made causes sometime breach of embankment takes place and the resultant flow of water through the broken points of the embankment, causes seveire flood leading to severe damage to human lives, animals and properties.
- ❍ Reservoirs : Heavy rainfall causes increase of water volume in the reservoirs and the quick rise in the water level causes floods in the nearby areas.

➢ *Effects of flood :* There are severe impacts of floods in the environment. Some of these include—

- ❍ Loss to agriculture : The prolonged accumulation of water causes the agricultural land to remain under water continuously as a result of which many agricultural crops like rice etc. can not survive long. This results in great financial losses for a family.
- ❍ Destruction of property : Severe floods can inundate and wash away homes as well as cause damage to vehicles, properties and lives.
- ❍ Diseases : The worst effect of flood is on one's health. Floods can cause the accumulation of various human wastes in the flood waters. Hence flood waters can spread to the other areas, resulting in the occurence of diseases such as Cholera and Malaria etc.
- ❍ Deaths : Floods also often result in loss of lives especially in low lying areas and along the river banks. Hundreds of deaths occur in our state on account of severe flood.
- ❍ Loss to Government : Floods damage public property such as roads, buildings, telephone lines and electrical equipment .Floods can also give rise to many kinds of diseases. The responsibility of repairing the damages and providing medical help lies mainly on the Government. This costs a lot and is a heavy economic loss to the government as well as to the public.

- *Mitigation measures :*
  - Non structural long term measures
    1. Afforestation : It is the first step for controlling floods. Forest prevents

       the rain water from directly coming into the land. Rain water falls through tree leaves on the ground and forests also help in more percolation of rain water and reduce the surface run off. It significantly reduces soil erosion and helps in reducing the frequency of floods.
    2. Flood forecasting and early warning system : Flood control organizations and forecasting centres set up in various parts of India help in the forecasting of floods in river basins like the Ganga, Brahmaputra and their tributaries. These flood forecasting centres collect the data regarding rainfall, and the level of flood water etc. and people living in the lower basins against the possible threat of flood.
    3. Zoning of flood prone areas : The flood prone areas are classified into certain zones based on the levels of risk the different areas have and the probability of hazard they face. This type of classification or zonation is useful in the management of flood hazard in the flood prone areas.
  - Structural measures (short term) :
    1. Storage reservoirs : The volume of water during the flood may be reduced through a series of engineering devices such as construction of storage reservoirs which help in irrigation as well as power generation.
    2. Straightening of bends : The existence of too many of bends in the highly sinuous and meandering rivers retard the quick disposal of water. So, it may be necessary to straighten the meandering courses of a river by performing artificial cutoff of individual bends so that flood discharge may move downstream without causing flood along its banks.

3. Diversion of flood : Flood diversion system implies the diversion of flood water in low lying areas through artificially constructed channels bordered by artificial dykes so that the devastation of floods can be reduced.
4. Embankments : Embankments, dikes and flood walls are used to confine the flood water within the valley or within a narrow channel. These engineering works include the building of artificial levees of earthen materials along the river banks. These are considered as short-tern measures for flood management. If these structures are used for a longer time, their usefulness is greatly reduced in managing flood flows.



CHECK YOUR PROGRESS

Q 4. What are the main causes of flood?

.....

Q 5. write about the steps involved in the process of structural flood mitigation.

.....

Q 6. Discuss the anthropogenic causes of flood.

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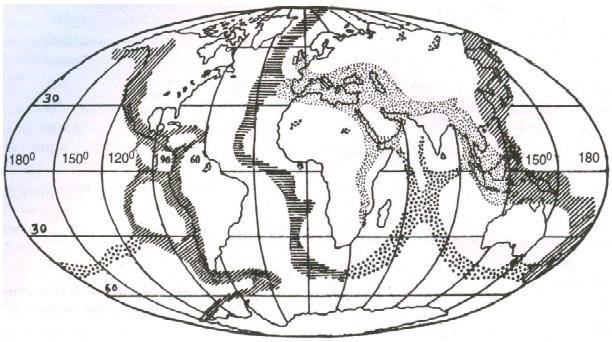
Stone spurs are also used to protect the towns; cities and other populated areas from severe erosion during flood .Semi permeable spurs, pile spurs are also constructed to protect against flood and erosion.

- **Earthquake Disaster:** The earthquake is a vibration of the surface of the earth with rocking energy of wave motion capable of shaking buildings apart and causing gaping fissures to open up in the ground.

  The magnitude or intensity of energy released by the earthquake is measured by the Richter scale.

  - *Causes of earthquake:* A number of factors are thought to be responsible for causing disequilibrium or isostatic imbalance in the earth's crust. Mainly natural factors and occassionally manmade

Figure. 6.1 : World distribution of earthquakes



factors are responsible for this disequilibrium. Natural causes like Volcanic activity, Plate tectonic movements, Faulting and Elasticity cause the occurance of earthquake. Anthropogenic causes like high explosions, breaching of dams also induce earthquake disaster.

- *Impact of earthquakes: T*he effects of earthquakes are divided as primary, secondary and transient effects depending upon the intensity, magnitude and severity of the occurance.
  - Primary effects
    a. Regional geological changes,
    b. Displacement of and cracks in any matter
    c. Fissures and cracks in buildings, roads etc.
    d. Elevation and depression of land.
    e. Accumulation of water.
    f. Change in the direction of river current.
    g. Formation of stream tremors in ponds and water bodies.
    h. Displacement of well and spring.
  - Secondary effects
    a. Landslide b. minor slippage
    c. Uprooting of poles and posts d. Death of fishes
    e. Common damage to buildings f. Effects on glaciers
    g. Stopping of pendulum clocks h. Snapping of cables.
  - Transient effects
    a. Perceptible tremors b. Sliche in rivers and ponds

c. Tsunami d. Swaying of bridges

e. Shaking of buildings f. Birds/animals disturbed

g. Fright and panic among human beings

h. Hearing of sounds.

- *Mitigation measures:* The damages to property and loss of lives associated with earthquakes are due to the fact that the tremors often strike without warning .A great deal of research is being devoted to the problem of early forecasting and warning. Some of the mitigation measures are as follows—
  - Long term prediction : Prediction of earthquake is still found not possible. However, with increased precision in measurement and advancement in analytical techniques, the risks due to earthquake hazards faced by different locations on the earth surface are better known today based on which mitigation measures can be taken.
  - Hazard mitigation programme : (1) Development of awareness program for earthquake hazard, (2) To make the public aware of effects of earthquakes, (3) Aplication of various research results on earthquakes.
  - Adjustment to the earthquake activity : Structural protection— near the epicentral area damage is not very high. But outside areas are mostly affected and so structural protection is encouraged. Structures should be very light and should be able to absorb the shocks. The foundation of the buildings should be strong. Steel frame with reinforced concrete is most suitable.
  - Land use planning and earthquake zonation : Identification of Earthquake prone areas is most important and microzonation studies are to be encouraged. Schools, hospitals and other public buildings should be made earthquake resistant and safe.
  - Warning system and rescue camps : Early warning systems as in other countries like USA (Loss Angels) should be used where seismometers, transmitters, satellite based technologies

are employed for monitoring and transmission. Post disaster relief operations should be taken up properly with the help of the government.



CHECK YOUR PROGRESS

Q 7. Write the definition of earthquake.

.....

.....

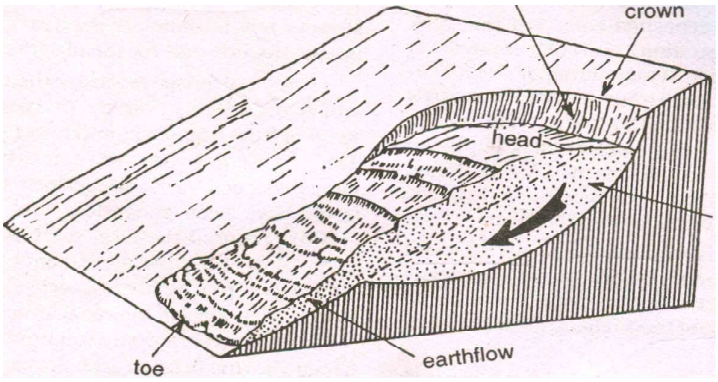
Q 8. Discuss the secondary effects of earthquake.

.....

.....

- **Landslide Disaster:** A landslide is a slow or sudden downhill movement of soil , glacier and rock materials due to the force of gravity. Landslides as erosional processes not only modify the existing topography and landscape, but also cause immense damage to man made structures causing heavy loss of lives and properties.

Figure. 6.2 : Landslide occurrence(After AL Bloom, 1978).



➢ *Causes of landslides*

❍ Natural cause

(i) Internal factors :

a. Increase in pore water pressure

b. Presence of Kaolinite, anhydric or expansive clays like montmorillonite

d. Weathering and physico-chemical reactions.

(ii) External factors:

a . Gravitational force

b. Prolonged and continuous rainfall

c. Ground water flow through loose soils

d. Wedging action of plants and tree roots

e . Tremors due to earthquake.

- Manmade causes
  a. Clearing of vegetation and cutting of slopes.
  b. Vibration due to drilling, blasting and operations of earth moving machines.
  c. Excessive ground water tapping from slopes.
  d. Construction of buildings, roads, drainage and over loading of slopes, effect of septic systems.

- *Landslide hazard effects:*
  - Damage and destruction of highways, railways, canals, bridges, forest etc. in terrain.
  - Caving in of big buildings
  - Destruction of useful underground materials
  - Cracks in plasterers, brick and stone masonry, floor and foundations
  - Flow of water from pools, reservoirs towards the lower regions.
- *Landslide mitigation:*

  Drainage, Grading reduces landslide occurrence. Slope modifications—-
  - Slope modifications : Toe cutting ,terrace cutting should be stopped and the heavy pressure on the gradient should be minimized. Retraining structures—retraining walls, buttresses, pilings etc. and Grunting and grouting techniques are effective.
  - Afforestation : Afforestation programmes should be properly planned so that there is no effect on the slope.The selection of plant species should be such that it can withstand the pressure on the terrain.

- Warning system : With the help of scientific experience, measurement of landslide-prone areas, geological data and weather and rainfall forecast and landslide warning system many developed countries have developed methods which can forecast disasters and warn the people.



LET US KNOW

For the movement of any mass, the most important factor to be considered is the 'safety factor' which is the ratio between shearing forces(stress)and resistance of the materials to these forces as expressed below —

$$Fs = \frac{\text{Shearing resistance of the material}}{\text{Magnitude of shearing forces}}$$

- **Drought Disaster:** A drought can be defined as an extended period of months or years which a region experiences. This condition is usually experienced due to the insufficiency in rainfall, lack of irrigation facilities, under exploitation of the available water sources and non availability of adequate amount of water for meeting the normal crop requirement for agriculture.
  - *Causes:* Drought is related to the failure of the normal rains at a particular time. All those natural and human activities which affect rainfall and water resources are the causes of drought. Some of these causes are—
    - Less amount of water vapor in the air due to the occurrence of hailstorms may result in drought.
    - Wind is another natural factor which helps in the shifting of air masses
    - El-nino which increases the temperature of the water in oceans also influences the climate of the different parts of the world.
    - Injudicious destruction of trees for agriculture or constructional activities combined with the resultant erosion causes the loss of moisture from the land areas and ultimately results in drought.

- *Impacts:* The problems associated with drought can have economic, environmental, and social impacts. Because nature and human society depend on water. Lack of water results in the migration of people. It is a very common occurence. The agricultural sector is particularly affected by drought. The lack of water can often cause a decline in crop yields, leading to the reduction in income for farmers and an increase in the market price of products. A prolonged drought, may cause unemployment of farmers and problems for the retailers of agricultural products, having a significant impact on the economy of the area. Health problems like malnutrition, dehydration and spread of various diseases become a common sight in a drought-hit area. Drought can also result in insect infestations and plant diseases, increasing erosion, habitat and landscape degradation, forest fire, wild fire etc. Prolonged drought like condition leads to desertification.
- *Mitigation measures:* Afforestation is the most effective way to increase the content of air moisture, precipitation, rate of infiltration of rainwater and thus replenishment of ground water and raising of the water table. Soil and water conservation is another important step. Water conservation by desalination of seawater, water recycling, construction of reservoirs, rainwater harvesting, introduction of dry farming techniques to reduce the dependence of farming on rainwater, checking of desertification or desert spread and the development of horticulture and pastures are some of the measures that help in drought mitigation.

- **Tsunami Disaster:** Tsunami is a giant, vast ,rare and deadly series of sea waves produced by submarine earthquake or volcanic eruption or slides under water. Tsunami is a Japanese word meaning tsu (harbor) and nami (wave). The term is pronounced soo-NAA-mee. It is a natural phenomenon consisting of a series of waves generated when water in a lake or a sea is rapidly displaced on a massive scale. The effects of a tsunami can sometimes be quite insignificant but sometimes these are highly devastating.

- *Causes:* The tsunami is caused by earthquakes, volcanic eruptions, explosions under the sea.
- *Impact of tsunami:* Tsunami has a devastating and catastrophic effect when it becomes a hazard. Tsunami affects the coastal areas very harshly. The records of the tsunamis that have already taken place point to the destruction of huge number of coconut trees in the coastal areas besides causing a devastating impact on human lives and properties. The hazards of tsunami have taken a heavy toll of human lives. Many people had left their home and hearth in the tsunami affected areas and being homeless came to live in refugee camps.
- *Mitigation measures:* Government has established a nationwide warning system after the devastating experience of tsunami and it is linked to the Pacific Tsunami Warning Centre (PTWC) in Ewa Beach, Hawaii. After an earthquake seismographic information is transmitted over satellite signals to the Central Station, which forwards it to the headquarters in Hawaii and Chiang Mai.. Finally, people are warned through warning towers, via radio . Another new system has been developed recently by the National Research Centre for Geosciences in Potsdam, Germany. This is the most effective, fast and better determination system and is based on the measurement of water pressure after an earthquake. This system has more advantages than all other systems.



CHECK YOUR PROGRESS

Q 9. Fill in the blanks

a) Prolonged drought like condition leads to .....

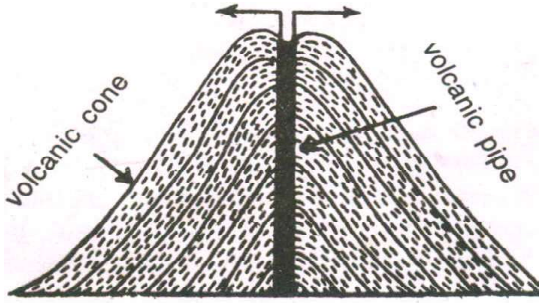
b) Tsunami is a Japanese word of which 'tsu' means ..... and 'namee' means .....

Q 10. Write in brief the natural causes of drought occurrence.

.....

- **Volcanic Disaster:** A volcano is essentially a fissure or vent ,communicating with the interior, from which the flows of lava, fountains of incandescent spray or explosive bursts of gases and volcanic ashes erupt at surface. Volcanism includes all phenomena connected with the movement of heated material from the interior to or towards the surface of the earth.

Figure. 6.3 : Different components of a volcano



Volcanic vent *crater*

- *Causes:* Volcanoes are always associated with the weaker zones of the earth's crust. The main causes associated with the volcanic eruption are : mountain building, faulting and fracturing, Tectonic plates, the Pacific "Ring of fire" in the Pacific ocean and some spreading centers**.**
- *Hazardous effects of volcanic eruptions:* Volcanic eruption causes heavy damage to human lives, property and all ecosystems through emitting hot lavas and volcanic materials. Huge volumes of hot and liquid lavas moving at considerably fast speed burry structures, kill people and animals, destroy agricultural farms, forests. These volcanic substances including dusts and ashes, smokes etc. cover the large ground surface and farm lands, forests, men and animals and create acid rains. Volcanic eruption also changes the radiation balance of the earth the and atmosphere and thus helps in causing climatic changes. According to some scientists volcanic eruptions cause mass extinction of a few species. Volcanos occuring before and after an earthquake generate destructive tsunamis seismic waves.

- *Mitigation measures:* Regular measurement of seismic events and earth tremors is very much necessary. In the earthquake prone regions volcanic eruption can be predicted by using the Teltmeter. Constant measurement of the temperature of the crater lakes, hot springs, geysers and fumaroles also give some indications about the possible eruption of a volcano in a particular locality. Measurement of the local gravity and the magnetic field and their trends may also help in the prediction of a volcano. The risk of a Volcanic eruption in densely populated areas may be considerably reduced only if governmental and nongovernmental organizations collaborate with the population at risk, and if economic incentives are provided for the reorganization of the productive resources on the territory.



CHECK YOUR PROGRESS

Q 11. Write the definition of volcano.

.....

.....

Q 12. Write true or false.

a. Volcanoes are always associated with the weaker zones of the earth's crust.

.....

b. Volcanic eruptions and fallout of dusts and ash cause mass extinction of a few species.

.....

6.7 MANMADE DISASTERS

- **Industrial (Chernobyl disaster):** Chernobyl is a city in Northern Ukarine, Soviet Union which was evacuated on 25th April,1986 due to the nuclear disaster at the Chernobyl power plant located 14.5 kilometer north-west. The power plant is within Chernobyl Raion.It was a sad day for all the people of ukarine. The explosion took place at around one in

the morning while the neighboring town of Pripyat was asleep. Four workers were killed instantly.

The Chernobyl Nuclear Power Plant near the town of Pripyat, Ukraine, exploded at around 1.23 A.M .A nuclear reactor burst through a 4000 ton steel concrete cover and the reactor's core temperature was 2000^0C. The accident spread all kinds of toxic substances in the nearby areas causing severe impact in the whole environment including plants and animals. The accident triggered the release of substantial amounts of radiation into the atmosphere in the form of both particle and gaseous radio isotops which were 400 times more radioactive.

- *Impact of the accident: Short term effects :* As a result of the explosion radioactive cloud with fires drifted over Russia, Belarus, Ukarine and some other parts like Turkey, Romania, Finland, Denmark, Norway and Sweden. The inhalation of the air mixed with radioactive substances increased the risk of cancer to the affected people. 203 persons were hospitalized and 38 died. 135,000 people were evacuated from the area; 10 persons had already died of cancer after the accident. Chernobyl Unit 4 reactor contained about 180-190 metric tons of radioactive uranium oxide ..About 10,500 km ² (4,000 mi²) area was contaminated by caesium-137. Some other health hazards like blood abnormalities, thyroid damage, atrophy, cataract, fibrosis etc. had appeared. 10%of the trees were damaged immediately by the radiations.
- *Long term effects :* This is a very controversial issue. Over 300,000 people of the area were rehabilitated in some other places after the disaster. There was evidence of increased mortality, cancers or birth defects among these people.

- **Fires:** Though fires sometimes occur due to some natural causes yet most of the time human activities are primarily responsible for the incidence of fire. Many human activities like camp fires, explosions, careless handling of machines in industries, chemical laboratories ,wars and social conflicts, atomic researches cause fire. This is a very

frequent and common problem in the highly industrial metropolitan areas.

Fire accidents cause severe economic loss as well as environmental degradation. The forest fires used in connection with agricultural activities inflict great loss to the wild life habitats. Hundreds of trees are destroyed and animals lose their habitat. Infact, some species of animals and trees may totally get extinct leading to a huge biodiversity loss. Fire accidents in some industries take hundreds of lives, cause loss of properties and affect the whole environment.

Therefore, some steps need to be taken to cope up with this disaster. People should be very careful while handling machines, using chemicals and lighting fire in camps. Emergency services should always be kept ready to face such eventualities

- **Accidents:** An accident is an instantaneous, unexpected and unplanned sequence of events that cause ruinous effect on property, lives and the environment.

  Accidents are caused due to both natural and manmade activities. Natural causes include mainly natural geological processes like earthquake, landslides, erosion etc. On the other hand, accidents due to manmade causes include sudden explosions in the industries, head on collision of motor vehicles etc.

  These sudden accidental events can be mitigated through the emergency services provided by the government and NGOs, proper planning of the cities and awareness of the people.

- **Oil Spills:** The release of liquid petroleum hydrocarbon into the water bodies due to anthropogenic activities is referred to as oil spills which cause severe pollution of the water body and the whole environment as well. This type of incident is very common in the marine environment only.

  Oil spill is mostly caused by sudden accidents or leakage of oil tankers, cleaning of the tankers in shore areas, leakage of oil from the refinery and other fuel industries.

➢ *Effects* **:**

- ❍ Effects on birds : This oil penetrates through the feathers to the body of a bird and impairs the bird's flight abilities, making it difficult or impossible for it to defend itself against predators. This oil also damages. kidneys and the liver function, poisoning the digestive tract. Seals and Dolphins are also affected while feeding on the contaminated species. The reproductive function of the animals is also affected by the oil spill.
- ❍ Effects on fishes : Fish species are badly affected by this kind of pollution. Oil enters into their bodies through gills, affects the eggs and the larval survival. Reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion, and reproductive impairment are the other adverse effects of oil spills on fishes noticed. Oil has the potential to impact the spawning success, as eggs and larvae of many fish species, including Salmon, are highly sensitive to this toxic substance.
- ❍ Effects on invertebrates : Oil can directly affect the invertebrates by altering their metabolic activities.
- ❍ Effects on plants : Some small plants, algae, and other aquatic plants are also affected badly.

The pollution caused by oil spills can be reduced by some bioremediation and phyto remediation techniques using some bacteria to remove the oils from the water body. Some chemical methods are also used to reduce this pollution.



CHECK YOUR PROGRESS

Q 13. Write True or False.

a. Chernobyl disaster was a nuclear power plant accident.

b. Oil spills cannot affect plants.

Q 14. Fill in the blanks.

a. The release of liquid petroleum..... causes oil spill problem in water bodies.

b. In oil spills penetrates through the feathers of a bird and affects its activities.

c. Oil can directly effect the invertebrates by altering its .... activities.



6.8 LET US SUM UP

- After going through this unit you must have learnt to define disaster, how it differs from hazard, risk and vulnerability, and the types of disasters. This unit has also discussed the major disasters, the causes, effects and the mitigation measures in the event of a major disaster. Disaster is the result of the hazardous events causing economic loss, loss of lives and environmental degradation.
- Basically there are two types of disasters – natural and manmade. Both natural causes and manmade activities are behind the incidence of major disasters like floods, earthquake, landslides, volcanoes. They cause severe damage to the environment.
- This unit has helped you to learn about the specific causes ,effects and mitigation measures of these ruinous events. The structural and non structural mitigation measures against floods, landslide disasters etc. have been elaborately discussed along with some other severe forms of disasters like tsunami, volcanoes, drought etc. The measures to be taken to mitigate their severe effects are also mentioned in course of this discussion.
- Finally, the unit acquaint the learners with the Chernobyl disaster with its devastating oil spills impact occurring due to manmade activities. People should be made aware about the effects of these hazards and their mitigation measures. We have also given some questions and examples to enable you to have a better understanding of the concept of disasters.



6.9 FURTHER READING

1) Singh, R.B. (2009). *National Hazard & Disaster Management. Vuluerability and Mitigation.* Delhi: Rawat Publication.
2) Singh, S. (2008). *Environmental Geography.* Allahbad: Prayag Pustak Bhawan.
3) Talwar, A. K. & Juneja. S. (2008). *Encyclopaedia of Disaster Management (Set of 10 Vols.).* Commonwealth Publishers.
4) Talwar, A. K. & Juneja. S. (2009). *Hazardous Materials Disaster Management.* Commonwealth Publishers.
5) Talwar, A. K. & Juneja. S. (2009). *Human Made Disaster Management.* Commonwealth Publishers.
6) Talwar, A. K. & Juneja. S.(2009). *Natural Disaster Management.* Commonwealth Publishers.



6.10 ANSWER TO CHECK YOUR PROGRESS

Ans to Q No. 1: "Disaster" is a sudden, unexpected and adverse natural or manmade event causing significant physical damage, loss of life or property, including permanent changes of the natural environment.

Ans to Q No. 2: a. True b. False

Ans to Q No. 3: Hazardous event

Ans to Q No. 4: a. Natural causes b. Manmade causes

Ans to Q No. 5: a. Storage reservoirs b. Cutting of sinuses
c. Diversion of flood d. Embankments

Ans to Q No. 6: a. Deforestation b. Urbanization
c. Breach of Dams/Embankments
d. Reservoirs e. Agricultural practices

Ans to Q No. 7:. The earthquake is a vibration of the surface of the earth with rocking energy of wave motion which is capable of shaking the buildings apart and causing gaping fissures to open up in the ground.

Ans to Q No. 8: a. Perceptible shaking b. Sciche in rivers and ponds
c. Tsunami d. Swaying of bridges
e. Shaking of buildings.

Ans to Q No. 9: a) unemployment of farmers.
b) harbor , wave.

Ans to Q No. 10: a) Less amount of water vapour in the air due to the occurrence of heavy rainfall and hail storms results in dryness of the air. This sometimes causes drought.
b) Wind is another natural factor which helps in the shifting of air masses

Ans to Q No. 11: A volcano is essentially a fissure or vent,communicating with the interior, from which erupt the flows of lava, fountains of incandescent spray or explosive bursts of gases and volcanic ashes.

Ans to Q No. 12: a. True b. True

Ans to Q No. 13: a. True b. False

Ans to Q No. 14: a. hydrocarbon b. plumage c. metabolic



6.11 POSSIBLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. Bring out the differences between hazard and disaster.

Q 2. What are the primary, secondary and transient effects of earthquake?

SHORT ANSWER QUESTIONS

Q 1. Elaborate on the structural and non structural mitigation measures for flood disaster.

Q 2. How does oil spill affect the wild life?

LONG ANSWER QUESTIONS

Q 1. Write briefly about the internal and external factors associated with landslide hazards.

Q 2. What are the environmental impacts of drought?

Q 3. Describe the causes and effects of Tsunami.

Q 4. Briefly describe the effects of volcanic hazard on the environment.

*** **** ***

UNIT 7: DISASTER MANAGEMENT

UNIT STRUCTURE

7.1 Learning objectives
7.2 Introduction
7.3 Disaster Management
7.4 Safety measures immediately before a disaster
7.5 Emergency Aid
7.6 Methods or steps to be taken for disaster management
7.7 NGOs and participation of civil society
7.8 Regional disaster management and planning
7.9 Let us sum up
7.10 Further reading
7.11 Answers to check your progress
7.12 Possible questions

7.1 LEARNING OBJECTIVE

After going through this unit, you will be able to

- define disaster management
- know about the precautionary measures to be taken for disaters
- learn about emergency aid/measures
- know about the measures to be taken during disaster.
- define the role of NGOs and the civil society in disaster management
- know about regional disaster and its management.

7.2 INTRODUCTION

In the previous unit, you must have read about disaster -its types and some natural and man made disasters. This unit will focus on disaster management. Disasters are of sudden occurrence. Ordinarily the occurrence of a disaster doesnot give any indication before it takes place. All kinds of disasters cannot be prevented but with due planning these can be reduced to some extent and their effects could be lowered. It is

often difficult to make a definite prediction about a disaster. But on account of technology and dedicated professional services the occurrence of a disaster can be foreseen and with due preparation it can be minimized. In this unit we will learn about how disaster can be managed. Meaning of disaster, preventive measures for disaster, precautions that are to be taken, the role of voluntary organizations and the civil society participation and as well as regional disaster management will be discussed in this unit.

7.3 DISASTER MANAGEMENT

A disaster ,whether it is a man made or due to natural causes, may have devastating effects. We cannot stop the loss or damage caused by disaster. But it can be reduced to some extent. This is called disaster management. Disaster is a sudden occurrence and it does not give any kind of warning before its occurrence. Earthquakes, floods, soil erosion, big industrial accident, deforestation caused by fire, volcanic eruption, cyclical storm ,cyclical sea waves, hail storm, Tsunami Tides, thunder-storm, drought, terrorist attack, natural or man made accidents are all different forms of disaster. Men's various activities are to some extent responsible for the occurrence of a disaster that causes loss or damage to lives and property But precautions/preventions if taken in advance can reduce the impact of disaster to some extent. For this we should take methodical and pre-planned steps. Skilled planning can also prevent in reducing the impact of disaster. Different kinds of disaster need different measures or precautions to prevent or reduce their impact. The U.N.O in 1987 took a very important proposal in this regard. According to this proposal, the 1990-2000 decade was declared as the International Natural Disaster Prevention decade. This proposal consists of the following :

- Every state should increase its capability of predicting a disaster and organizing its management.
- The loss or damage caused by Natural disaster should be minimized. The present and future scientific measures for prediction of such disasters should be expanded .

- Analysis of natural disaster, its solution and future prediction should be given the priority. .
- There should be a provision of possible guidelines and planning regarding disaster management .



CHECK YOUR PROGRESS

Q 1. From which year was an awareness about disaster started by the U.N.O.?

.....

7.4 SAFETY MEASURES IMMEDIATELY BEFORE A DISASTER

When we talk about the forewarning of a disaster we are expected to say that *" there is a possibility of occurring earthquake of 7.5 richter scale at such place with such year of time or a disaster to happen – the possibility of occurring an earthquake cannot be ruled out "* . There must be some definite quantitative value . The basic aim / purpose of these fore warnings is to minimize the amount of loss and damage to be caused by such earthquakes . It can be seen that the impact of natural disasters is felt most in the developing and underdeveloped countries. The main reason behind this is that these countries lack both the essential infrastructure and an integrated planning for disaster management . At the same time the population increase is another reason for the greater loss and damage on account of a disaster .

- **Pre Alertness:** For remaining alert in advance before a disaster occurs there should be scientific planning and so that we can face a disaster. Every country should have the capability to organize the warning system before a disaster . Besides , different organizations should be given responsibility to create an awareness about disasters among the people. The following disaster management organizations are mentioned stage wise :

	Stage		Organisation
1)	National	-	Home Ministry, Central aid and re-employment department
2.	State	-	Disaster Management Department
3)	District	-	Office of the District and Magistrate
4)	Sub-division	-	Office of Civil S.D.O.
5)	Block development	-	Block development office
6)	Panchayat	-	Panchayat Samity Office

Apart from these, there are various govt and non governmental organizations which are associated with disaster management. They are Police department, Para-military forces, Civil defence, Home guard, Fire service, National Cadet corps. National services, Nehru Yuvak Kendra, international agencies like FAO, ILO, UNDP, UNFPA , UNICEF, WEP, WHO, Red Cross Society, various national and international NGOs, private and public voluntary organizations . Data collected from satellites (Digital Data) help to analyze it. With the use of these systematic data , we can make use of the information, theory and technology of various geographical and scientific collection, analysis classification, simplification, transformation etc.

- **Fore Warning of Disaster on the Basis of Systematic Data Collection:** It is very difficult to predict a disaster and studies need to be conducted regarding various disasters .Nowadays excepting earthquakes, other kinds of disaster can be predicted. According to an international research journal “Nature” the earthquake can also be predicted. Nowadays, extensive studies have been undertaken and considerable amount of information technology is being used for prediction of disasters. It is possible to make timely use of this information technology to scientifically collect different geographical data, analyse, classify , simplify, transform and present them and as per requirement use them. Information gathered from satellites has played an important role in predicting a national disaster. For example, Indian Weather report institution through the medium of Television (T.V.)

has telecast weather report. In India, through the help of satellite (digital data), information regarding drought, flood, cyclone etc is disseminated among the public. Indian satellites like IRS-IC, IRS-ID, IRS-P3 satellites, are used to examine the status of flood and its management and through its help even the maps of flood affected areas are being prepared.

- **Decision Based on Informative System:** It has now become easier to prepare forewarnings of disaster on the basis of the present informative system. In this respect WMO has taken steps with the help of information , collection and research to find out the main reasons of disasters. The possibility of disaster taking place can also be predicted on the basis of statistical theory and historical information. It is very difficult to give precise advance warning but the probability can be referred to. For example, an advance warning can be such that there is a 70% to 80% possibility of the occurrence of an earthquake at such place (within coming year). This advance warning doesnot indicate that this possible earthquake cannot happen within some days or within the coming 20 years. It is a very complex matter to prepare advance warning on the occurrence of earthquake on the basis of such information. Information system has played a significant role in evaluating disaster and its management . For , these purposive modes of analysis enriched with information contribute to the adoption of effective practical decisions by the administrators and the voluntary and welfare institutions . In recent times , it has been possible to arrive at better decisions by applying the techniques of GIS and remote sensing.

  The technique of presenting , analyzing or unifying the physical, social, economic or political characteristics collectively or separately through the medium of maps with geographical significance is called GIS (Geographical Informative System) . If a model can be prepared using satellite based maps by collecting information on any zone or region their planning for disaster management and the implementation can be more effectively done .

- **Preparation / Guidelines for Disaster Management:** Natural disasters are the sudden unexpected natural processes or events that

cause significant damage or loss of life and property and affect the environment . Although we cannot stop a disaster yet we can atleast prevent or reduce the damage to some extent. For this, we need a methodical planning and management strategy .

We have to identify the areas or the zones which are vulnerable to a disaster or a calamity. Public awareness is necessary for taking precautionary measures before and after a disaster. Earth quake zones and the structures which are vulnerable to earthquakes should be identified. Proper roads and open areas and infrastructures are to be identified for the rescue operations at the time of disasters. The chief aim of preparing the plans should be to effect proper coordination among the various organizations , to train them up , to create awareness among the different sections of the people and to ensure the active cooperation of the govt. administration, non govt and voluntary organizations and the people.

Another important task is to keep the concerned departments ready for disaster management . Some of the media to be used during a disaster are Wireless Telephone, mobile phone, satellite phone, computer network etc.

- **CReating Awareness Among School Going Children:** One of the important steps to create an awareness about disaster management is to sensitize the school children . We can recall that at the dawn on 26th Dec. 2004 , Tsunami devastated the Indian Coastal areas of Kerala, Tamil nadu, Andhra Pradesh, Andaman and Nicobar island taking a toll of one thousand lives . Following this event in the year 2005, Indian govt. introduced in the CBSE curriculum lessons for creating awareness about Tsunami at all India level. As a result, the school children are being taught the do's and don'ts of facing the situation when a disaster takes place and when it passes over . A survey was conducted by Asian Disaster Reduction Centre (ADRC) in 2005 in Sri Lanka, Maldives and Indonesia in which school children, faculties and the general public were included . Its main aim was to give training in

disaster management and to show how the loss and damage caused by disaster could be reduced to some extent. The study revealed that through proper training a disaster could be mitigated to a considerable extent . Another revelation from the research was that more than 90.4% school students liked to read about disaster. Through school children their family members would also become aware about the precautionary measures connected with disaster. In order to popularize the measures for mitigating disasters among the general public , it is essential to include it as a compulsory subject for the school children and the necessary syllabus has to be prepared for the purpose . About 34 million school children in the world are expected to fall victim to a disaster. So it is likely that the school buildings may collapse during an earth quake in earthquake prone areas if these are not constructed as resistant to earthquakes.

- **Safety Measures / Actions:** Planning the safety measures is highly essential for inculcating awareness among the school children. Under the auspices of LOL UNDP Disaster Risk Management Programmes safety instructions/ guidelines have been prepared for schools by the Govt of India . The main aim of this is to give training about the precautionary measures to be taken before a disaster.

  The items that are included under safety guidelines are the following – Inclusion of the subject of disaster management in the curriculum, to increase awareness , provide education and training in different stages to the public and the government employees, mock drill, formation of disaster management committee in school , safety measures to be taken in the construction of buildings, to develop technology to mitigate disaster, conducting workshops with the help of electronic network, newsletter etc. Keeping in view these safety guidelines the security advisory councils involving every class should be formed in schools .



CHECK YOUR PROGRESS

Q 2. Which Indian organization is contributing to disaster management?

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Q 3. In which year was a course on disaster management included in the CBSE curriculum.

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7.5 EMERGENCY SERVICES

After a natural disaster, emergency services should be provided to the living and the injured people or animals who are badly affected by disaster. Whether an earthquake or any other form of disaster occurs or not , the level of preparedness of the disaster management authority/ department depends on how they keep ready the materials for rescue operations , how the damage or loss of lives is controlled and how far they could ensure the supply of drinking water, electricity, first aid, public relation and emergency services.

- **Supply of Water:** In case of disaster, like flood, supply of drinking water is necessary and for that the mouth of the tube well should be closed and bleaching powder is to be put in the well etc . Water should be taken after boiling and if required alternative water supply is to be arranged.
- **Supply of Electricity:** Usually electricity is disrupted during and after a disaster Therefore there should be an alternative provision for it . Alternative sources of power such as solar energy should be utilized for it. Electricity should be restored immediately. The electricity department should be prepared to restore electricity. For this, special training should be given to the employees . During a disaster, there is a possibility of short circuit ;so to avoid that the buildings should have provision for fire extinguishers. If possible, the supply of electricity should be stopped for that period. Torch light should be kept ready by everyone

so that it can be used during the disaster. Additional battery set, torch light, hurricane lamp are to be kept ready .

- **Infrastructure:** Generally ,during a disaster , infrastructures and the roads in particular suffer extensive damage . In case of Assam , flood affects the roads and causes communication problems . Storm destroys the newly built roads . Therefore the Public Works Department should remain prepared to face such an eventuality of loss or damage caused by hazards. The earthquake in in 1950 in Assam brought massive destruction to the railway tracks and caused big craters on the roads . The engineers and the staff of the PWD Department should be given proper training to remain vigilant against disasters and it is one of the important aspects of disaster management .
- **Relief Camps:** After a disaster organizing relief camps and their management become absolutely necessary . In particular during floods, shifting the flood affected people and animals to higher grounds is imperative . Volunteer groups should be formed for managing the relief camps . Separate toilets for males and females, drinking water, medicine, bleaching powder, brooms , tent, dry food, gas lamp, torch etc are necessary. These are the some of the things are to be arranged. The names of the refugees in relief camps should be systematically recorded. Special care needs to be taken for women , children , elderly persons and who are sick .
- **First Aid:** Sudden disaster causes loss of human lives , physical injuries, and also diseases. Sometimes dispensaries are also affected. So to mitigate such disaster, some medicines and trained staff should be made ready.. First aid kit should be kept ready and such kits contain:
  - Cotton cloth and pashmina cloth
  - Adhesive tape
  - Crepe Bandage
  - Sterile dressing
  - Triangular Bandage
  - Thermometer
  - Scissor

- Glasses/ Gloves
- Soap
- Pain reliever
- Antacid
- ORS Packet

Alongwith the doctor, there should be an ambulance. If required, provision should be there to shift patients from relief camps to hospitals for better treatment. It is essential to form a group for prevention of contagious diseases and the members should be given proper training for the purpose . Besides , necessary food items are to be kept in store for future use if an epidemic occurs.

- **Communication:** Nowadays government and non government organizations associated with disaster management are playing a significant role in the management of the communication system . Communication system includes the means of transport such as motor cars, railway, aeroplane, post, doordarshan, besides tele communication etc . Some of the important communication media are Telephone, mobile phone, wireless set, Telex, Fax, satellite, phone, internet , etc .In case of a disaster, alternative communication is needed. Storm , earthquake, landslides, flood etc disrupt the communication. So, in such a situation, the alternative communication is used and these activities are included under communication management. Generally it is seen that due to lack of cooperation among various departments entrusted with responsibilities for this purpose , the loss of lives and damage of property as result of disasters increase manifold . If the forewarning of a disaster could be telecast then the damage could be reduced to some extent. In 2004, on December 25th when Tsunami occurred in Tamil Nadu . Andaman and Nicober island , radio broadcast was very successful in giving information.

  Radio and Doordarshan play a significant role in giving warning and providing counseling in case of an impending disaster.

- **Mutual Co-operation:** It is necessary to have mutual cooperation among various organizations, departments and those who actively participate in disaster management. Without mutual cooperation, it is not possible to transform into reality any plan connected with disaster management. The general Public, Govt. officials, employees and the non govt. organizations should have mutual cooperation among themselves to rescue the people from such disasters. In fact all sections of the people must be involved in a war footing manner on a united effort to fight disasters.
- **Formation of Rescue groups:** Rescue groups should be formed and properly trained up for the rehabilitation of the victims of disaster. The rescuers should keep the required items ready such as helmet, torch, gumboots, life jacket, whistle etc to help the victims .

  Rescue operators should have rope, ladder, small wheel, knife, first aid box, axe, etc. In case of a disaster, the chief role of the rescuers or life savers would be to take the victims to relief camps and hospitals. The members of the rescuer groups should be sober, gentle, intelligent, capable of decision making, well built and determined males or females. They should be more than 18 years of age. Preferably , rescue operators should be selected from army background or from among the local people. They should survey the affected areas and collect data from there. The members of rescue groups should have co-operation and coordination among them.selves.
- **Essential services in disaster management:** Essential services play a very important role in disaster management. The essential services are providing food , woolen clothes, bedding, utensils, gas etc, drinking water, first aid, etc. There should be good coordination among these services during a disaster.

7.6 STEPS TO BE TAKEN DURING DISASTER

There should be proper planning for the post disaster measures so that the loss can be minimized . Some of the steps that are to be taken after a disaster are–

- To rescue people from the calamity as fast as possible
- To identify the living, injured and the dead people and to keep their records .
- To keep the communication network from getting disrupted.
- To guard against the possible theft of essential articles ..
- To arrange temporary relief camps and to provide drinking water, medicine and electricity.
- To ensure the supply of essential things like food, woolen/warm clothes, bedding, utensils etc.
- To ensure adequate transport facilities in the affected areas
- To check the loss of lives and damage.
- To arrange the rehabilitation of the affected people and to take steps to bring back normalcy .
- To prepare a detailed report of loss and damage .

- **Relief Camps:** Establishing and organizing relief camps after a disaster takes place is very important. The affected people need special help for rehabilitation after a disaster . For instance, after a disaster , first aid, drinking water, food, seeds for cultivation etc are some of the important items needed by the disaster affected people . Under these circumstances the government and NGOs should act together in organizing the relief camps and the government should provide the necessary first aid , relief materials , rescue materials , food and medicines to the organizations managing the relief camps .
- **Resources:** During the disaster period the flow of required funds to deal with the loss and destruction will depend on the supply of the funds by the public and private organizations . To ensure the flow of funds in the post disaster periods the following steps need to be taken:
  - Every government should have some special funds to be spent for relief measures for disaster .
  - It should be strictly monitored so that the funds are utilized only for the disaster affected areas and for the specific purpose . The

amount of fund needed for pre- disaster and post disaster periods will be determined by proper guidelines

- Special insurance schemes should be made for disaster prone areas .
- Special funds are to be allotted for relief measures
- The various industrial and commercial organizations , educational institutions ,private companies etc are to be encouraged for forming relief funds .
- The financial institutions disbursing loans for constructing houses should ensure that necessary precautions are taken in constructing house .

- **Things that are Needed During a Disaster:** During the post disaster period certain essential things are required and providing these essential things is one of the major tasks . Some of the essential things are – food, water bottles, warm cloths, radio, paper, pen, old newspapers, soap, tooth paste, tooth brush , things that are used by small kids, heavy shoes, candle, knife, etc.

  To provide, the above mentioned things, disaster management committees should appoint some organizations and trained workers who can act and distribute the relief materials as per requirement to the victims.

- **Providing Relief after a Disaster:** To provide relief after a disaster is the primary responsibility of the National Crisis Management Committee under the central Government. Apart from that, various social groups and organizations have been playing an important role. It is essential to have co-ordination among all these groups to mitigate a disaster. Particular attention is to be given to the following in the post disaster period :
  - Improvement in transport and communication .
  - Providing safe drinking water
  - Maintaining proper electricity, telephone and sanitation
  - Managing the required food, shelter and clothes.

- To keep accurate account of loss and damage
- To ensure the supply of seeds for cultivation and other facilities.

- **Planning for the Required Action in Post Disaster Period:** The required guidelines have already been prepared at the national level . But it is essential to prepare the guidelines for actions to be undertaken by concerned departments. High level committees at the central , state and district levels are needed to tackle the problems during disasters . Committees are also to be set up at the gaon Panchayat level. At the district level some special groups are to be formed such as rapid action force, rescuers, first aids, primary health care, management of relief camps, drinking water etc . Besides, there should be groups to look after sanitation, survey for payment of compensation, and relief works.
- **Psychology of the Affected People During Disaster:** The mindset of the disaster victims is gravely affected by natural disasters and their adverse effects . Many people attribute such disasters to fate . Dissater affected people usually suffer from a sense of insecurity as a result of which they are inflicted with fear , mental tension, depression , irritation and loss of sleep . The department of disaster management should take up special measures to change this mindset of the affected people. Flood is an unavoidable natural disaster in Assam . Some special measures need to be taken to make people live with the disaster of floods .
- **Providing Assistance for Rehabilitation:** During the post disaster period special assistance is needed for the rehabilitation of the victims. For example , it is necessary to provide seeds to the cultivators after floods. For this , the agriculture department should arrange for sowing of paddy seeds at higher plains . Reconstruction of the damaged infrastructure is another important task in the post disaster period. Besides, professional suggestions need to be sought from the concerned professionals to deal with the devastation caused by disasters .



CHECK YOUR PROGRESS

Q4. What would you do if during a disaster electricity fails?

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Q5. Do you see any change of mind in the case of residents of disaster affected areas?

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7.7 PARTICIPATION OF NGOs AND SOCIETY

In order to survive at the time of disasters it is important for the various communities in the society to remain alert. In this case , the NGOs are expected to take important steps Those who are engaged in disaster mangaemnt are to be properly trained and well prepared. In this respect the participation of voluntary organizations, NGOs and sections of the society may make positive impact. The voluntary organizations and the different communities need to share mutual cooperation for this . For its effective implementation the concerned people are to be particularly responsible for and aware about the immediate rescue operations , rehabilitation and improvement of the environment . For this is needed a year long plan of action as well as the competence to tackle the situation immediately . The voluntary organizations should remain ever ready to create an awareness among the different sections of the society. For example , during the monsoons advance warning about floods about to occur , relief steps to recover the losses etc can be imparted to the people besides ensuring the distribution of relief materials , medicines , seeds and other things . The poor people have to suffer untold miseries during a disaster , caused by destruction of houses and land becoming unfit for cultivation. The voluntary organizations are to extend both long term and short term help in this situation .

7.8 REGIONAL DISASTER MANAGEMENT AND PLANNING

Disaster management in general is a united effort of different departments through effective coordination. National Disaster management involves the planning for preparedness , prediction, warning for disaster, relief and rehabilitation, repair and reconstruction. For this different departments are to be involved at different levels and made ready through proper training for disaster management . The administrators, scientists , planning officers and various sections of the society have to play a vital role in this . Organisations and various social institutions should be engaged in coordinated work before and after a disaster. For this in different levels, training is to be conducted for readiness for a disaster. In this regard, administration, science, planning commission, NGO and various communities play a very important role. Already Natural Hazard Management Authority (NHMA) has identified probable hazards and have informed public. This organization of govt. of India has adopted various schemes and works in association with NGOs in this regard. It includes maps of hazardous/risk zones, etc. In urban areas, guidelines of hazard proof houses and bridges are to be prepared.



CHECK YOUR PROGRESS

Q 6. What is the role of regional disaster management?

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7.9 LET US SUM UP

- Whether it is man made or due to natural causes , a disaster causes grave impact on the human society. We cannot stop a disaster and its

devastating effect but we can reduce the damage or loss caused by it to some extent. This is called disaster management.

- The first and foremost aim of early prediction of disaster is to see that the loss and damage caused by a disaster can be reduced . The impact of disaster is more severe in the developing countries because there are lacunae in disaster management. In these countries , increasing population and high poverty levels are other important factors responsible for greater incidence of hazards .
- Some of the measures that can be adopted to mitigate disasters are given below :
  - Early prediction.
  - On the basis of information gathered, early prediction and preparedness
  - On the basis of data, decision to be taken.
  - Disaster management plan.
  - Awareness among school children
  - Safety measures.
- Emergency services connected with disasters as follows
  - Water supply.
  - Electricity
  - Managing relief camps
  - First aid
  - Communication
  - Mutual co-operation
  - Formation of rescue groups
  - Essential services and maintainence of law and order.
- Measures to be taken at the time of disaster.
  - Building relief camps
  - Security of resources
  - Arrangement of essential items after a disaster
  - Planning for the required action during disaster
  - Relief during a disaster

- Aid for rehabilitation
- The psychological condition of the victims after disaster

- To survive in disaster it is important for various communities in society to remain alert. Specially, NGO's should take important steps in this regard .
- The Natural Hazard Management Authority (NHMA) have identified areas of possible hazard.



7.10 FURTHER READING

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7.11 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: 1990-2000

Ans to Q No 2: Home Ministry, Central Aid and Rehabilitation Department.

Ans to Q No 3: 2005

Ans to Q No 4: There should be an alternative provision for it . Solar energy and other such kind of energy should be utilized for it .

Ans to Q No 5: Can be possible

Ans to Q No 6: Map of hazardous zone



7.12 PROBABLE QUESTIONS

VERY SHORT ANSWER QUESTIONS

Q 1. What do you mean by disaster management ?

Q 2. What is an emergency aid ?

SHORT ANSWER QUESTIONS

Q 1. Write a short note on the measures to be taken during a disaster.

Q 2. Write a short note on Regional Disaster Management and Planning Commission.

LONG ANSWER QUESTIONS

Q 1. Discuss some emergency aids during a disaster ?

Q 2. Explain with examples the role of voluntary organizations and the society in general in disaster management ?

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