SKDAV
GOVT.POLYTECHNIC
ROURKELA

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Year & Semester: **2ND Year, III Semester**

Subject Code/Name: TH-5, ENVIRONMENTAL STUDIES

VISION OF THE DEPARTMENT-

To be a center of excellence in the field of E&TC Engineering by providing qualitytechnical education.

MISSION OF THE DEPARTMENT-

1. To create an excellent teaching learning environment for making the studentsacquire the knowledge needed.
2. To inculcate self-learning attitude, entrepreneurial skill.
3. To impart knowledge required for recent and advanced engineering.

PROGRAM EDUCATIONAL OBJECTIVE (PEO)-

1. Recognize and apply the acquired fundamental knowledge in basic science andmathematics in solving E&TC Engineering problems.
2. To gain employment in public and private sector organization.
3. Involve in higher study and career enhancement.

PROGRAM SPECIFIC OUTCOME (PSO)-

1. To design, test and troubleshoot the simple analog and digital circuits.
2. An ability to solve complex E&TC Engineering problems using various tools i.e., hardware and software.
3. To pursue higher studies or get placed in various industries.

COURSE OUTCOME (CO)-

After the completion of the course the students are able to-

CO1- Apply knowledge (methods) to restore natural resources and bring harmony to the nature and use resources in a way at a rate that does not lead to the long-term degradation of the environment, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

CO2- Apply technologies and options used to remediate reduce/eliminate pollution of the environment

CO3- Analyse, synthesise, and evaluate evidence to understand problems and accordingly select control measures and techniques concerning atmospheric, water or terrestrial challenges.

CO4- Diagnose the cause of environmental pollution and design appropriate control measures, waste disposal methods in urban and rural context to improve the health outcomes.

CO5-Understand population limitation can facilitate the development of a higher quality of life in the nation.

UNIT-1

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

INTRODUCTION

The word 'Environment' is derived from the French word 'Environner' which means to encircle, around or surround. The biologist Jacob Van Uerkal (1864-1944) introduced the term 'environment' in Ecology. Ecology is the study of the interactions between an organism of some kind and its environment. As given by Environment Protection Act 1986, Environment is the sum total of land, water, air, interrelationships among themselves and also with the human beings and other living organisms. Environmental Science is the interdisciplinary field and requires the study of the interactions among the physical, chemical and biological components of the Environment with a focus on environmental pollution and degradation. Environment studies is a multidisciplinary subject where different aspects are dealt with in a holistic approach. The science of Environment studies comprises various branches of studies like chemistry, physics, life science, medical science, agriculture, public health, sanitary engineering, geography, geology, atmospheric science, etc. It is the science of physical phenomena in the environment. It studies the sources, reactions, transport, effect and fate of a biological species in the air, water and soil and the effect of and from human activity upon these. Environmental Science deals with the study of processes in soil, water, air and organisms which lead to pollution or environmental damages and the scientific basis for the establishment of a standard which can be considered acceptably clean, safe and healthy for human beings and natural ecosystems.

The Environment is about the surrounding external conditions influencing development or growth of people, animal or plants; living or working conditions etc. This involves three questions ie., what is surrounded, by what surrounded and where surrounded. The answer to the first is living objects in general and man in particular.Human life is concerned to be the main in the study of environment. However, human life cannot exist or be understood in isolation from the other forms of life like animal life and from plant life. Environment belongs to all living beings and is thus important for all. Hence, environment refers to the sum total of conditions surround in space and time. The scope of the term 'Environment' has been changing and widening by the passage of time. In the primitive age, the environment consisted of only physical aspects of the planet earth ie., land, water and air as biological communities. As of now, it includes social, economic and political conditions also.The answer for the question where surrounded is in nature that physical component of the planet earth, viz land, air, water etc., support and affect life in the biosphere..

DEFINITIONS OF ENVIRONMENT:

Some important definitions of environment are as under:

1. According to Boring, 'A person's environment consists of the sum total of the stimulation which he receives from his conception until his death.' Indicating that environment comprises various types of forces such as physical, intellectual, mental, economical, political, cultural, social, moral and emotional.
2. Douglas and Holland defined that 'The term environment is used to describe, in aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms'.

Scope of environmental studies:

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

1. The study creates awareness among the people to know about various renewable and non-renewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.
2. It provides the knowledge about ecological systems and cause and effect relationships.
3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganisms in the environment.

4. The study enables one to understand the causes and consequences due to natural and main induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.
5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.
6. The study enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.
7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.
8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.
9. It teaches the citizens the need for sustainable utilization of resources as these resources are inherited from our ancestors to the younger generating without deteriorating their quality.
10. The study enables theoretical knowledge into practice and the multiple uses of environment.

Importance of environmental study:

Environmental study is based upon a comprehensive view of various environmental systems. It aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems. The citizens acquire the ability to analyze the environmental parameters like 2 the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and anthrosphere.

Importance

- ☞ World population is increasing at an alarming rate especially in developing countries.
- ☞ The natural resources endowment in the earth is limited.
- ☞ The methods and techniques of exploiting natural resources are advanced.
- ☞ The resources are over-exploited and there is no foresight of leaving the resources to the future generations.
- ☞ The unplanned exploitation of natural resources leads to pollution of all types and at all levels.
- ☞ The pollution and degraded environment seriously affect the health of all living things on earth, including man.
- ☞ The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.
- ☞ Education and training are needed to save the biodiversity and species extinction.
- ☞ The urban area, coupled with industries, is major sources of pollution.
- ☞ The number and area extinct under protected area should be increased so that the wildlife is protected at least in these sites.
- ☞ The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- ☞ The study motivates students to get involved in community action, and to participate in various environmental and management projects.
- ☞ It is a high time to reorient educational systems and curricula towards these needs.
- ☞ Environmental studies take a multidisciplinary approach to the study of human interactions with the natural environment. It integrates different approaches of the humanities, social sciences, biological sciences and physical sciences and applies these approaches to investigate environmental concerns.
- ☞ Environmental study is a key instrument for bringing about the changes in the knowledge, values, behaviours and lifestyles required to achieve sustainability and stability within and among countries.

Need For Public Awareness:

Due to many discoveries and inventions from 16th century onwards, man has overexploited the natural resource which leads to many environmental problems such as acid rain, ozone layer depletion, greenhouse effect, landslides, cancer and other health problems. Lack of awareness and a smaller number of people participation leads to poor pollution management which are the major reasons for climate instability and unhealthy ecosystem. Hence, it is necessary to create awareness to the public about environmental problems and to protect the environment through implementing proper regulations.

In order to protect the environment from the pollution, Supreme court has initiated the environmental awareness to the public through government and non-governmental agencies.

And it is important duty of us to cooperate with government from our side and work for the protection of environment.

UNIT-2
NATURAL RESOURCES

Resources obtained from nature, i.e. from the earth are called **natural resources**. These resources occur naturally, and humans cannot make them. The raw materials used in artificial or man-made resources are natural resources.

Classification of Natural Resources:

1. Renewable Natural Resources

Resources that can be used without any risk of its ending up are called renewable resources. They exist in unlimited quantity. Sun, water, wind, biomass, tides, geothermal energy, etc. are renewable resources. These are infinite sources of energy.

2. Non-renewable Natural Resources

Those natural resources, on the other hand, that cannot be replenished after their depletion is called non-renewable resources. Most fossil fuels, such as coal, petroleum and natural gas are considered non-renewable resources. Non-renewable resources take billions of years for their formation, hence, their cautious and economic use is the only option left for mankind.

FOREST RESOURCES

Forest is important renewable resources. Forest varies in composition and diversity and can contribute substantially to the economic development of any country. Plants along with trees cover large areas, produce variety of products and provide food for living organisms, and also important to save the environment.

It is estimated that about 30% of world area is covered by forest whereas 26% by pastures. Among all continents, Africa has largest forested area (33%) followed by Latin America (25%), whereas in North America Forest cover is only 11%. Asia and former USSR has 14% area under forest. European countries have only 3% area under forest cover. India's Forest Cover accounts for 20.6% of the total geographical area of the country as of 2005.

Significance of forests

Forest can provide prosperity of human being and to the nations. Important uses of forest can be classified as under

- ☞ Commercial values
- ☞ Ecological significance
- ☞ Aesthetic values
- ☞ Life and economy of tribal

Uses of the forest:

1. Commercial values

- Forests are main source of many commercial products such as wood, timber, pulpwood etc. About 1.5 billion people depend upon fuel wood as an energy source. Timber obtained from the forest can used to make plywood, board, doors and windows, furniture, and agriculture implements and sports goods. Timber is also a raw material for preparation of paper, rayon and film.
- Forest can provide food, fibre, edible oils and drugs.
- Forest lands are also used for agriculture and grazing.
- Forest is important source of development of dams, recreation and mining.

2. Life and economy of tribal

Forest provides food, medicine and other products needed for tribal people and play a vital role in the life and economy of tribes living in the forest.

3. **Ecological uses**

Forests are habitat to all wild animals, plants and support millions of species. They help in reducing global warming caused by greenhouse gases and produces oxygen upon photosynthesis.

Forest can act as pollution purifier by absorbing toxic gases. Forest not only helps in soil conservation but also helps to regulate the hydrological cycle.

4. **Aesthetic values**

All over the world people appreciate the beauty and tranquillity of the forest because forests have a greatest aesthetic value. Forest provides opportunity for recreation and ecosystem research.

Over exploitation of forests

Forests contribute substantially to the national economy. With increasing population increased demand of fuel wood, expansion of area under urban development and industries has lead to over exploitation of forest. At present international level we are losing forest at the rate of 1.7 crore hectares annually. Overexploitation also occurs due to overgrazing and conversion of forest to pastures for domestic use.

Deforestation

Forest are burned or cut for clearing of land for agriculture, harvesting for wood and timber , development and expansion of cities .These economic gains are short term where as long term effects of deforestation are irreversible

Deforestation rate is relatively low in temperate countries than in tropics If present rate of deforestation continues, we may losses 90% tropical forest in coming six decades

For ecological balance 33% area should be under forest cover but our nation has only 20.6% forest cover.

Causes of deforestation:

Forest area in some developed area has expanded. However, in developing countries area under forest is showing declining trend particularly in tropical region. Main causes of deforestation are:

a) Shifting cultivation or jhum cultivation

This practise is prevalent in tribal areas where forest lands are cleared to grow subsistence crops. It is estimated that principal cause of deforestation in tropics in Africa, Asia and tropical America is estimated to be 70, 50, and 35% respectively. Shifting cultivation which is a practice of slash and burn agriculture are possessed to clear more than 5 lakh hectares of land annually. In India, shifting cultivation is prevalent in northeast and to limited extent in M.P, Bihar and Andhra Pradesh and is contributing significantly to deforestation.

b) Commercial logging

It is a important deforestation agent. It may not be the primary cause but definitely it acts as secondary cause, because new logging lots permits shifting cultivation and fuel wood gatherers access to new logged areas.

c) Need for fuel wood

Increased population has led to increasing demand for fuel wood, which is also acting as an important deforestation agent, particularly in dry forest.

d) Expansion for agribusiness

With the addition of cash crops such as oil palm, rubber, fruits and ornamental plants, there is stress to expand the area for agribusiness products which results in deforestation.

e) Development projects and growing need for food

The growing demand for electricity, irrigation, construction, mining, etc. has led to destruction of forest. Increased population needs more food which has compelled for increasing area under agriculture crops compelling for deforestation.

f) Raw materials for industrial use

Forest provides raw material for industry, and it has exerted tremendous pressure on forest. Increasing demand for plywood for backing has exerted pressure on cutting of other species such as fir to be used as backing material for apple in J&K and tea in northeast states.

Major effects of deforestation

Deforestation adversely and directly affects and damages the environment and living beings. Major causes of deforestation are:

- ☞ Soil erosion and loss of soil fertility
- ☞ Decrease of rain fall due to effect of hydrological cycle.
- ☞ Expansion of deserts
- ☞ Climate change and depletion of water table
- ☞ Loss of biodiversity, flora and fauna
- ☞ Environmental changes and disturbance in forest ecosystems

Case studies

1. Jhum cultivation

Jhum Agriculture or shifting agriculture has destroyed large number of hectares of forest tracts in North-Eastern states and Orissa. Jhum agriculture is subsidence agriculture in which tract of forest land is cleared by cutting trees and it is used for cultivation. After few years, when productivity of the land decreases, cultivators abandon the land and clear next tract. As a result of this practise, combined with increasing population there is rapid deforestation as more and more cultivators clear forest to cultivate land. Also, with increase in population there is cultivators are forced to return to previous tracts of land in relatively shorter durations, not allowing the land to regain its productivity.

2. Chipko movement

The Chipko movement or Chipko Andolan is a social-ecological movement that practised the Gandhian methods of satyagraha and non-violent resistance, through the act of hugging trees to protect them from being felled. The modern Chipko movement started in the early 1970s in the Garhwal Himalayas of Uttarakhand, with growing awareness towards rapid deforestation. The landmark event in this struggle took place on March 26, 1974, when a group of peasant women in Reni village, Hemwalghati, in Chamoli district, Uttarakhand, India, acted to prevent the cutting of trees and reclaim their traditional forest rights that were threatened by the contractor system of the state Forest Department. Their actions inspired hundreds of such actions at the grassroots level throughout the region. By the 1980s the movement had spread throughout India and led to formulation of people-sensitive forest policies, which put a stop to the open felling of trees in regions as far reaching as Vindhyas and the Western Ghats.

3. Western Himalayan region.

Over the last decade, there has been widespread destruction and degradation of forest resources in Himalayas, especially western Himalayas. This has resulted in various problems such as erosion of top soil, irregular rainfall, changing weather patterns and floods. Construction of roads on hilly slopes, have not only undermined their stability, but also damaged protective vegetation and forest cover. Tribes in these areas are increasingly facing shortage of firewood and timber, due large-scale tree cutting. Increased traffic volumes on these roads leads to increased pollution in the area.

Timber extraction:

There has been unlimited exploitation of timber for commercial use. Due to increased industrial demand; timber extraction has significant effect on forest and tribal people.

Logging

- ➢ Poor logging results in degraded forest and may lead to soil erosion especially on slopes.

- New logging roads permit shifting cultivators and fuel wood gatherers to gain access to the logging area.
- Loss of long-term forest productivity
- Species of plants and animals may be eliminated.
- Exploitation of tribal people by contractor.

Mining

Major effects of mining operations on forest and tribal people are:

1. Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining. It leads to degradation of lands and loss of topsoil. It is estimated that about eighty-thousand-hectare land is under stress of mining activities in India
2. Mining leads to drying up perennial sources of water sources like spring and streams in mountainous area.
3. Mining and other associated activities remove vegetation along with underlying soil mantle, which results in destruction of topography and landscape in the area. Large scale deforestation has been reported in Mussoorie and Dehradun valley due to indiscriminating mining.
4. The forested area has declined at an average rate of 33% and the increase in non-forest area due to mining activities has resulted in relatively unstable zones leading to landslides.
5. Indiscriminate mining in forests of Goa since 1961 has destroyed more than 50000 ha of forest land. Coal mining in Jharia, Raniganj and Singrauli areas has caused extensive deforestation in Jharkhand.
6. Mining of magnetite and soapstone have destroyed 14 ha of forest in hilly slopes of Khirakot, Kosi valley and Almora.
7. Mining of radioactive minerals in Kerala, Tamilnadu and Karnataka are posing similar threats of deforestation.
8. The rich forests of Western Ghats are also facing the same threat due to mining projects for excavation of copper, chromites, bauxite and magnetite.

Effects of dams on forests and tribal people:

Dams are the artificial barriers constructed across mountains to arrest water. The main purpose of construction of dam is to store water for future use. However, these dams are also responsible for

- the destruction of forests.
- degradation of catchment areas,
- loss of flora and fauna,
- increase of water borne diseases,
- disturbance in forest ecosystems,
- rehabilitation and resettlement of tribal peoples.
- Cause of floods, droughts and landslides

WATER RESOURCES

Introduction

Water is an indispensable resource for life on earth. Approximately 70.8 % surface of earth is covered with water in the form of oceans. Out of this, about 97% is not fit for human consumption, about 2% is locked as a glacier and only less than 1% available as fresh water that can be used for human consumption and other uses.

Water resources in world

Water is a very important source and essential for life because it has very unique characteristic such as

1. Water exists as liquid over a wide range of temperature 0-1000C with highest specific heat and latent heat of vaporization.
2. Water is excellent solvent and act as carrier of nutrient and helps to distribute them to the cells in the body, regulates the body temperature and support structure and can dissolve various pollutant and can act as carrier of large number of microorganisms
3. It is responsible for hydrological cycle which acts as resource of water to the earth. It is estimated that about 1.4-inch-thick layer of water evaporates and majority of water returns to earth through hydrological cycle.

Water Use

More than 99% of earth water is unavailable for use; only 1% water is available for people, animal, plants and earth. There is an uneven distribution of water resources, tropical rain forest are receive maximum rainfall where as desert receive only little rainfall.

Due to its unique properties water is of multiple uses for all living organisms. Water is absolutely essential for all the living organisms. One can survive for weeks without food but cannot survive more than a few days without water. Since the earliest days of mankind water availability was the major factor to decide the place of human settlements. Water dissolves nutrients and distributes them in different parts of plants and regulates the temperature and removes the waste.

Over-Exploitation of Water:

Groundwater

About 9.86% of the total freshwater resources are in the form of groundwater and it is about 35-50 times that of surface water supplies.

Effects of extensive and reckless groundwater usage:

1. Subsidence
2. Lowering of water table
3. Water logging

Surface water

Surface water mainly comes directly from rain or snow covers. The various surface sources are natural lakes and ponds, rivers and streams, artificial reservoirs. Availability of surface water decides the economy of the country. On one side surface water availability affects the productivity, but on the other side water sources may cause floods and drought. Due to unequal distribution, water may lead to national (interstate) or international disputes. Sharing of surface water due to these disputes is affecting productivity of different agro eco-zone and creating problems for government.

Recently many water conflicts at national and international levels relating to sharing of surface water are catching the headlines of newspaper.

Floods

A flood is an overflow of water, whenever the magnitude of flow of waterexceeds the carrying capacity of the channel within its banks.

CAUSES OF FLOODS

- ☞ Heavy rainfall, melting of snow (ice), sudden release of water from dams often causes floods in the low-lying coastal area.
- ☞ Prolonged heavy rainfall can also cause the overflowing of lakes and rivers resulting in floods
- ☞ Reduction in carrying capacity of river channels due to accumulation of sediments or obstructions built on flood ways.
- ☞ Deforestation, overgrazing, mining increases the run-off from rains causing floods.
- ☞ Removal of dense and uniform forest cover over the hilly zones leads to occurrence of floods.

EFFECT OF FLOODS:

Due to floods:

- ☞ Water spreads in the surrounding areas and submerges them
- ☞ Plain surfaces get eroded and silted with mud and sand thereby affecting cultivable land areas.
- ☞ Extinction of civilization in some coastal areas also occurs.

FLOOD MANAGEMENT:

- ➢ Floods can be controlled by constructing dams or reservoirs.
- ➢ Channel management and embankments also control floods
- ➢ Encroachment of flood ways should be banned
- ➢ Flood hazard may be reduced by forecasting or flood warning
- ➢ Flood hazard may be reduced by reduction of runoff and this can be achieved by increasing infiltration through appropriate afforestation in the catchment area.

Draughts:

Drought is scarcity of water. Drought occurs due to:

- ☞ inadequate rainfall
- ☞ late arrival of rains and
- ☞ excessive withdrawal of groundwater

Scarcity of water for normal needs of agriculture, livestock, industry or human population may be termed as drought.

Drought is understood from dry weather which persists long enough to produce a serious hydrological imbalance, leading to damage of plants, animals and human life.

TYPES OF DROUGHTS:

Droughts are classified into four types:

1. Meteorological Drought occurs when the total amount of rainfall is less than 75% of normal rainfall. This drought will be severe if the rainfall is less than 50% of the normal rainfall
2. Hydrological Drought occurs when the total amount of rainfall is less than the average rainfall. It is generally associated with reduction of statistical average of water reserves available in the source such as aquifers, lakes and reservoirs.
3. Agricultural Drought occurs due to the shortage as well as the timing of overall rainfall. This form of drought reduces groundwater and reservoir levels. Agricultural Drought affects cropped plants.
4. Socio-economic Drought occurs due to reduction in the availability of food and social security of people in the affected areas. Socio-economic drought leads to famine.

CAUSES OF DROUGHT:

- When annual rainfall is below normal and less than evaporation, drought occurs
- High population also leads to drought. Population growth leads to poor land use and worsens the situation
- Intensive cropping pattern and over-exploitation of scarce water resources by digging wells or bore-wells for high productivity has turned drought prone areas into desert. Ex:- Over exploitation of water resources for sugarcane in Maharashtra has prevented the state from drought recovery for the past 30 years.
- Deforestation leads to desertification and drought. Deforestation leads to the top soil exposed to erosion by heavy rains, wind and the sun. Thus the top layer of soil rich in nutrients gets washed away making the soil unproductive. Eroded soils exhibit a droughty tendency.

EFFECTS OF DROUGHT:

1. Drought causes hunger, malnutrition and scarcity of drinking water. It also degrades the quality of drinking water.
2. Drought causes widespread crop failures leading to acute shortage of food thereby adversely affecting human and livestock populations.
3. Drought indicates the initiation of desertification.
4. Raw materials for agro-based industries are critically affected during drought thereby retarding industrial and commercial growth.
5. Drought accelerates degradation of natural resources.
6. Drought leads to large scale migration to urban areas thereby creating slums.

DROUGHT MANAGEMENT:

1. Indigenous knowledge in control of droughts and desertification is very useful for dealing with drought problems
2. Rainwater harvesting program is very useful technique used to conserve water and control drought
3. Construction of large capacity reservoirs is essential in drought prone areas
4. Modern irrigation techniques (drip irrigation) is very useful to conserve water and avoid wastage
5. Afforestation activities improve the potential of water in drought prone areas
6. Mixed cropping and dry farming are suitable methods that minimize the risk of crop failure in dry and drought prone areas.

Water Conflicts

Water conflict is a term describing a conflict between countries, states, or groups over the rights to access water resources. Some of the major water conflicts that have become thorn in relations between states and countries are:

☞ **Water conflict in the middle east**

Countries involved are Sudan, Egypt and Turkey. It also affects countries which are water starved viz. Saudi Arabia, Kuwait, Syria, Israel and Jordan.

☞ **The Indus water treaty**

This Indus water treaty dispute between India and Pakistan is lingering since long.

☞ **The Cauvery water dispute:**

It involves two major states of India Tamilnadu and Karnataka.

☞ **The Satluj-Yamuna link canal dispute**

The dispute is between two Northern states viz. Punjab and Haryana and UP, Rajasthan as well as Delhi has also interest in it.

Dams - Benefits and Problems:

Water is a precious resource, and its scarcity is increasing at global level. There is a pressure to utilise surface water resources efficiently for different purposes. According to World Commission on Dam Report -2001 there are 45000 large dams spread over 140 countries

Major benefits of dams

The major benefits of dams are:

1. Hydroelectricity generation
2. Year-round water supply to ensure higher productivity
3. Equal water distribution by transferring water from area of excess to area of deficit
4. Helps flood control and protects soil
5. Assure irrigation during dry periods
6. River valley projects provide inland water navigation, employment opportunities and can be used to develop fish hatcheries and nurseries
7. River valley projects have tremendous potential for economic upliftment and will help to raise the standard of living and can help to improve the quality of life

Disadvantages/problems

Although dams have proved very useful over the centuries but recent past big dams has created lot of human as well as environmental issues

1. Submergence of large areas may lead to loss of fertile soil and displacement of tribal people
2. Salt left behind due to evaporation increase the salinity of river water and makes it unusable when reaches down stream
3. Siltation and sedimentation of reservoirs not only makes dams use less but also is responsible for loss of valuable nutrients
4. Loss of non-forest land leads to loss of flora and fauna
5. Changes in fisheries and the spawning grounds
6. Stagnation and water logging near reservoir leads to breeding of vectors and spread of vector-borne diseases
7. Growth of aquatic weeds may lead to microclimatic changes.

MINERAL RESOURCES

Introduction

Minerals are essential for the formation and functioning of organisms, plant animals and human beings. In the modern era, human life needs variety of minerals to sustain industry-based civilization. Mineral resources are broadly defined as elements, chemical compounds, and mixtures which are extracted to manufacture sustainable commodity. India has rich mineral resource base to provide suitable base for industrial development in the country. Sufficient reserve of nuclear energy minerals is available in India. India's reserves, as well as production are adequate in petroleum, ores of copper, lead, zinc, tin, graphite, mercury, tungsten, and in the minerals required for fertilizer industry such as sulphur, potassium and phosphorus.

Over Exploitation of Minerals

Depending on their use, mineral resources can be divided into several broad categories such as elements for metal production and technology, building materials, minerals for the chemical industry and minerals for agriculture. When usually we think about mineral resources, we often think of metals, but the predominant mineral resources are not metallic.

- Sodium and iron are used at a rate of about 0.1 to 1.0 billion metric tons per year.
- Nitrogen, sulphur, potassium and calcium are primarily used as fertilizers at a rate of about 10 to 100 million metric tons per year.
- Zinc, copper, aluminium and lead are used at a rate of about 3 to 10 million metric tons per year;
- Gold and silver are used at a rate of about 10 thousand metric tons per year.
- Out of all the metallic minerals, iron consumption is 95% of the metals consumed.

Thus, with the exception of iron, the non-metallic minerals are consumed at much greater rates than the elements used for their metallic properties.

Uses of Minerals:

Due to increased population, there is increased demand of minerals by the industry, transport, agriculture and defence preparation. Depletion of almost all known, and easily accessible deposits is anticipated in near future. Moreover, there may be shortage of some crucial elements such as mercury, tin, copper, gold, silver and platinum. The limited resource of phosphorus, which is an essential component of chemical fertilizers, is another area of concern.

Environmental Impacts of Mineral Extraction

Extracting and use of mineral resources can affect the environment adversely. Environmental affect may depend on factors such as mining procedures, ore quality, climate, size of operation, topography, etc. Some of major environmental impacts of mining and processing operations are as under

1. Degradation of land.
2. Pollution of surfaces and ground water resources.
3. Effect on growth of vegetation due to leaching out effect of minerals.
4. Surface water pollution and groundwater contamination lead to occupational health hazards etc.
5. Air pollution due to emission of gases.
6. Deforestation affects flora and fauna.
7. Rehabilitation of affected population.

Conservation of Minerals:

Conservation of minerals can be done in number of ways and these are as follows,

- Industries can reduce waste by using more efficient mining and processing methods.
- In some cases, industries can substitute plentiful materials for scarce ones.

- ❖ Some mineral products can be recycled. Aluminum cans are commonly recycled. Although bauxite is plentiful, it can be expensive to refine. Recycling aluminum products does not require the large amounts of electric power needed to refine bauxite.
- ❖ Products made from many other minerals, such as nickel, chromium, lead, copper, and zinc, can also be recycled.
- ❖ Strict laws should be made and enforced to ensure efficient management of mining resources.

Case Study

Ara villi mountains which cover about 10% of geographical area is rich source of minerals wealth. This mountain range play important role in control of climate and act as mini water shed. On the request of environmentalist, Honourable Supreme Court has passed the order to stop these mines in Rajasthan.

Marble mining near Rajsamant Lake has led to drying up of lake. Marble mining was stopped in December 2002. Recently, mining in Goa has attained the attention of the press and media and ultimately government has to take the decision to stop this mining.

FOOD RESOURCES

Introduction

Food is essential for growth and development of living organisms. These essential materials are called nutrients and these nutrients are available from variety of animals and plants. There are thousands of edible plants and animals over the world, out of which only about three dozen types constitute major food of humans.

Food sources

The majority of people obtain food from cultivated plants and domesticated animals. Although some food is obtained from oceans and fresh waters, but the great majority of food for human population is obtained from traditional land-based agriculture of crops and livestock.

World Food Problems

As per estimates of Food and Agriculture Organization (FAO), about 840 million people remain chronically hungry and out of this 800 million are living in the developing world. In last decade, it is decreasing at the rate of 2.5 million per year, but at the same time world's population is increasing. Target of cutting half the number of world's chronically hungry and undernourished people by 2015 will difficult to meet, if the present trend continues. Due to inadequate purchasing power to buy food, it is difficult to fulfil minimum calorific requirement of human body per day. Large number of people are in India are poor which can be attribute to equitable distribution of income. Food insufficiency can be divided into two categories into under-nourishment and malnourishment. Both of these insufficiencies are global problems.

Changes Caused by Agriculture and Overgrazing

From centuries, agriculture is providing inputs to large number of industries involved in production, processing and distribution of food. Accordingly, agriculture has significant effect on environment. The effects of agriculture on environment can be classified as local, regional, and global level. The agriculture also makes impact on the usage of land generally as follows:

1. Deforestation
2. Soil Erosion
3. Depletion of nutrients
4. Impact related to high yielding varieties (HYV)
5. Fertilizers related problems include micronutrient imbalance, nitrite pollution and eutrophication.
6. Pesticide related problems include creating resistance in pests and producing new pests, death of non-target organisms, biological magnification.
7. Some other problems include water logging, salinity problems and such others.

The carrying capacity of land for cattle depends upon micro climate and soil fertility. If carrying capacity is exceeded than land is overgrazed. Because of overgrazing the agricultural land gets affected as follows,

- Reduction in growth and diversity of plant species.
- Reduce plant cover leads to increased soil erosion.
- Cattle trampling leads to land degradation.

Effects of Modern Agriculture

For sustainable production modern techniques are used to enhance productivity of different cropping systems under different agro-eco-zones. Adoption of modern agricultural practises has both positive and negative effects on environment. Effects of modern agriculture are briefly discussed under different heads as under:

1. **Soil erosion**

Raindrops bombarding bare soil result in the oldest and still most serious problem of agriculture. The long history of soil erosion and its impact on civilization is one of devastation. Eroded fields record our failure as land stewards.

2. **Irrigation**

Adequate rainfall is never guaranteed for the dry land farmer in arid and semiarid regions, and thus irrigation is essential for reliable production. Irrigation ensures sufficient water when needed and also allows farmers to expand their acreage of suitable cropland. In fact, we rely heavily on crops from irrigated lands, with fully one-third of the world's harvest coming from that 17% of cropland that is under irrigation. Unfortunately, current irrigation practices severely damage the cropland and the aquatic systems from which the water is withdrawn.

3. **Agriculture and the loss of genetic diversity**

As modern agriculture converts an ever-increasing portion of the earth's land surface to monoculture, the genetic and ecological diversity of the planet erodes. Both the conversion of diverse natural ecosystems to new agricultural lands and the narrowing of the genetic diversity of crops contribute to this erosion.

4. Fertilizer-pesticide problems

For photosynthesis apart from water, sunshine and CO2, plants need micro and macro nutrients for growth. These nutrients are supplied in the shape of fertilizers. There is lot of potential to increase food productivity by increasing fertilizer use. On one hand application of artificial chemical fertilizers increases the productivity at faster rate as compared to organic fertilizers, on the other hand application of fertilizers can be a serious problem of pollution and can create number of problems. Excessive level of nitrates in ground water has created problems in developed countries. These are:

a. Accumulated phosphorous as a consequence of use of phosphoric fertilizer are posing serious threat as residues in domestic water supply and for ecology of river and other water bodies. Increased level of phosphates in different water results in eutrophication.

b. Effect of chemical fertilizer is long term, therefore leads to net loss of soil organic matter.

To control insects, pests, diseases and weeds which are responsible for reduction in productivity different chemicals are used as insecticides, pesticides and herbicides. Successful control of insects, pests and weeds increases productivity and reduces losses and provide security for harvest and storage. Applications of these synthetic chemicals have great economic values and at the same time cause number of serious problems such as:

a. Affects human health which includes acute poisoning and illness caused by higher doses and accidental exposes.

b. As long-term effect, cause cancer, birth defects, Parkinson’s disease and other regenerative diseases.

c. Long term application of pesticides can affect soil fertility.

d. Danger of killing beneficial predators.

e. Pesticides resistance and pest resurgence

Water Logging

High water table or surface flooding can cause water logging problems .Water logging may lead to poor crop productivity due to anaerobic condition created in the soil. In India, deltas of Ganga, Andaman and Nicobar Islands and some areas of Kerala are prone to frequent water logging.

Salinity

Due to adoption of intensive agriculture practices and increased concentration of soluble salts leads to salinity. Due to poor drainage, dissolved salts accumulate on soil surface and affects soil fertility. Excess concentration of these salts may form a crust on the surface which may injurious to the plants. The water absorption process is affected, and uptake of nutrient is disturbed. According to an estimate, in India, 7

million hectare of land is saline and area is showing in increasing trends due to adoption of intensive agriculture practises.

Case Studies

A study on birth defects in water birds, in Kesterson wildlife refuge in California, indicated that these defects were due to high concentration of selenium.

Recent reports from cotton growing belt of Punjab which covers Abohar, Fazalka and part of Bathinda indicates that overuse of pesticides for control of insect pest in cotton to enhance productivity has not only affected soil health, but also caused cancer in human being.

Diclofenac is the drug for veterinary use to treat the livestock which have strong residual nature, which leads to high persistence throughout the food chain. Due to biomagnification, it becomes more dangerous to the vultures as they are consumers of diclofenac treated cattle. Diclofenac is responsible for bringing three South Asian species of Gyps vultures to the brink of extinction. It has been banned in India since 2006.

ENERGY RESOURCES

Growing Energy Needs

Energy consumption of a nation is usually considered as an index of its development, because almost all the development activities are directly or indirectly dependent upon energy. Power generation and energy consumption are crucial to economic development as economy of any nation depends upon availability of energy resources. There are wide disparities in per capita energy use of developed and the developing nations. With increased speed of development in the developing nations energy needs are also increasing.

- The very original form of energy technology probably was the fire, which produced heat and the early man used it for cooking and heating purposes.
- Wind and hydropower have also been used. Invention of steam engineers replaced the burning of wood by coal and coal was further replaced by oil.
- The oil producing has started twisting arms of the developed as well as developing countries by dictating the prices of oil and other petroleum products.
- Energy resources are primarily divided into two categories viz. renewable and non-renewable sources.
- Renewable energy resources must be preferred over the non-renewable resources.
- It is inevitable truth that now there is an urgent need of thinking in terms of alternative sources of energy, which are also termed as non-conventional energy sources which include:
    1. Solar energy needs equipments such as solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace and solar power plants.
    2. Wind energy
    3. Hydropower, Tidal energy, ocean thermal energy, geothermal energy, biomass, biogas, biofuels etc.
- The non-renewable energy sources include coal, petroleum, natural gas, nuclear energy.

Renewable Resources

- The resources that can be replenished through rapid natural cycles are known as renewable resource.
- These resources are able to increase their abundance through reproduction and utilization of simple substances.
- Examples of renewable resources are plants (crops and forests),and animals who are being replaced from time to time because they have the power of reproducing and maintain life cycles.
- Some examples of renewable resources though they do not have life cycle but can be recycled are wood and wood-products, pulp products, natural rubber, fibres (e.g. cotton, jute, animal wool, silk and synthetic fibres) and leather.
- In addition to these resources, water and soil are also classified as renewable resources. Solar energy although having a finite life, as a special case, is considered as a renewable resource in as much as solar stocks is inexhaustible on the human scale.

Non-Renewable Resources

- The resources that cannot be replenished through natural processes are known as non-renewable resources.
- These are available in limited amounts, which cannot be increased. These resources include fossil fuels (petrol, coal etc.), nuclear energy sources (e.g. uranium, thorium, etc). metals (iron, copper, gold, silver, lead, zinc etc.), minerals and salts (carbonates, phosphates, nitrates etc.).
- Once a non-renewable resource is consumed, it is gone forever. Then we have to find a substitute for it or do without it.

- ❖ Non-renewable resources can further be divided into two categories, viz. Recyclable and non-recyclable.

Recyclable resources

These are non-renewable resources, which can be collected after they are used and can be recycled. These are mainly the non-energy mineral resources, which occur in the earth's crust (e.g. ores of aluminium, copper, mercury etc.) and deposits of fertilizer nutrients (e.g. phosphate sock and potassium and minerals used in their natural state (asbestos, clay, mica etc.)

Non-recyclable resources

These are non-renewable resources, which cannot be recycled in any way. Examples of these are fossil fuels and nuclear energy sources (e.g. uranium, etc) which provide 90 per cent of our energy requirements.

Use of Alternate Energy Sources

There is a need to develop renewable energy sources which are available and could be utilized (solar or wind) or the sources which could be created and utilized (biomass). The main renewable energy sources for India are solar, wind, hydel, waste and biomass. Biomasses are resources which are agriculture related like wood, bagasse, cow dung, seeds, etc.

Hydro energy

India has a total hydro energy potential of about 1.5 lakh MW, of which only about 20 % is installed. Small hydro plant potential is about 15000 MW and most of it is in the northern and eastern hilly regions.

Wind energy

The wind power potential of India is about 45,000 MW out of which capacity of 8748 MW has been installed in India till 2008. India is one of the leading countries in generating the power through wind energy.

Gujarat, AP, Karnataka, MP and Rajasthan are states having more than 5000 MW potential each. These potentials could be improved if the technology of putting turbines in sea is embraced. There are wind farms on sea generating as high as 160 MW of power.

Geothermal energy

Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. Earth's geothermal energy originates from the original formation of the planet (20%) and from radioactive decay of minerals (80%). Geothermal power is cost effective, reliable, sustainable, and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating, opening a potential for widespread exploitation. Geothermal wells release greenhouse gases trapped deep within the earth, but these emissions are much lower per energy unit than those of fossil fuels. As a result, geothermal power has the potential to help mitigate global warming if widely deployed in place of fossil fuels.

Ocean thermal energy conversion (OTEC)

Ocean Thermal Energy Conversion (OTEC) uses the difference between cooler deep and warmer shallow or surface ocean waters to run a heat engine and produce useful work, usually in the form of electricity. A heat engine gives greater efficiency and power when run with a large temperature difference. In the oceans the temperature difference between surface and deep water is greatest in the tropics, although still a modest 20 to 25 °C. It is therefore in the tropics that OTEC offers the greatest possibilities. OTEC has the potential to offer global amounts of energy that are 10 to 100 times greater than other ocean energy options such as wave power.

Biomass energy

Biomass is the oldest means of energy used by humans along with solar energy. As soon as the fire was discovered, it was used widely among humans mainly for heat and light. Fire was generated using wood or leaves, which is basically a biomass. The biomass could be used to generate steam or power or used as a fuel. Power is generated using rice husk in Andhra Pradesh, while several bagasse-based plants are there. India has a potential of 3500 MW from bagasse. Other fast-growing plants could be planned over a huge area, so that it provides biomass for generating power.

Organic waste such as dead plant and animal material, animal dung, and kitchen waste can be converted by the anaerobic digestion or fermentation into a gaseous fuel called biogas. Biogas is a mixture of 65% methane (CH4) and of 35% CO2 and may have small amounts of hydrogen sulphide (H2S), moisture and siloxanes. It is a renewable energy resulting from biomass. Biogas can be used as a fuel in any country for any heating purpose, such as cooking. It can also be used in anaerobic digesters where it is typically used in a gas engine to convert the energy in the gas into electricity and heat. Biogas can be compressed, much like natural gas, and used to power motor vehicles.

Bio-fuels

India has more than 50 million hectares of wasteland, which could be utilized for cultivating fuel plants. Jatropha is one of the options which can be planted on arid lands and be used for production of biofuels.

Solar energy

India being a tropical country has potential to use solar energy on commercial bases. According to estimates, 35 MW of power could be generated from one sq km. With such potential, solar energy has bright future as energy source for the development of the country. Initial cost is the biggest limitation which has led to the low realization of its potential. For solar energy to become one of the front runners, it will require lot of research, cheap technology and low capital.

Problems Relate to the Use of Energy Resources:

Fossil fuel:

- Global warming
- Acid rains
- Dangers posed by leaded fuels, Oil spills
- Water pollution caused by poorly managed coal mines
- Air pollution.

Alternate energy resources

- The initial cost of establishment of alternate energy generation is costlier than conventional resources.
- Maintenance of these structures is difficult.
- It requires more space.
- Energy supply is unpredictable during natural calamities.

Case Study

Importance of the energy resources in present economy and as a base for our future can be underlined by the fact that recent confrontations between some powerful nations of the world have primarily been attributed driven by objective to secure their energy supplies. Examples of this have been the two gulf wars. It was the hunger for energy resources that drove Iraq to lead an offensive over Kuwait and also reason for second Gulf war has been attributed to energy security by defence experts. In recent times, world has witnessed a confrontation at South China Sea between India, Vietnam and China over the issue of exploring natural gas and petroleum under the seabed.

LAND RESOURCES

Land as a Resource

Land area constitutes about 1/5 of the earth surface. To meet out the challenging demand of food, fibre and fuel for human population, fodder for animals and industrial raw material for agro-based industries, efficient management of land resources will play critical role. Soil, water, vegetation and climate are basic natural resources for agricultural growth and development.

Land Degradation

Due to increasing population, the demands for arable land for producing food, fibre and fuel wood is also increasing. Hence there is more and more pressure on the limited land resources which are getting degraded due to over-exploitation. Nearly 56% of total geographical area of the country is suffering due to land resource degradation. Out of 17-million-hectare canal irrigated area, 3.4 million hectare is suffering from water logging and salinity. Soil erosion, water logging, salinization and contamination of the soil with industrial wastes like fly-ash, press mud or heavy metals all cause degradation of land.

Man Induced Landslides

Human race has exploited land resources for his own comfort by constructing roads, railway tracks, canals for irrigation, hydroelectric projects, large dams and reservoirs and mining in hilly areas. Moreover, productive lands under crop production are decreasing because of development activities. These factors are affecting the stability of hill slopes and damage the protective vegetation cover. These activities are also responsible to upset the balance of nature and making such areas prone to landslides.

Soil Erosion

Soil erosion refers to loss or removal of superficial layer of soil due to the action of wind, water and human factors. In other words, it can be defined as the movement of soil components, especially surface-litter and topsoil from one place to another. It has been estimated that more than 5000 million tonnes topsoil is being eroded annually and 30% of total eroded mass is getting loosed to the sea. It results in the loss of fertility. It basically is of two types, viz. geologic erosion and accelerated erosion. Various factors which affect soil erosions include soil type, vegetation cover, slope of ground, soil mismanagement and intensity and amount of rainfall. Wind is also responsible for the land erosion through saltation, suspension and surface creep.

In order to prevent soil erosion and conserve the soil the following conservation practices are employed,

- Conservational till farming, Contour farming and Terracing
- Strip cropping and alley cropping
- Wind breaks or shelterbelts

Desertification

Desertification is a process whereby the productive potential of arid or semiarid lands falls by ten percent or more. Desertification is characterized by de-vegetation and depletion of groundwater, salinization and severe soil erosion.

Causes of desertification

- ☞ Deforestation
- ☞ Overgrazing
- ☞ Mining and quarrying
- ☞ Shifting Cultivation

Shifting cultivation is a practice of slash and burn agriculture adopted by tribal communities and is a main cause for soil degradation particularly tropical and sub-tropical regions. Shifting cultivation which is also popularly known as 'Jhum Cultivation' has led to destruction of forest in hilly areas. It is responsible for soil erosion and other problems related to land degradation in mountainous areas.

ROLE OF INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES

Natural resources like forests, water, soil, food, minerals and energy resources play an important role in the economy and development of a nation. Humans can play important role in conservation of natural resources. A little effort by individuals can help to conserve these resources which are a gift of nature to the mankind. Brief description of role of individual to conserve different types of natural resources is given below:

Roles to conserve water:

- ☞ To minimise the evaporation losses, irrigate the crops, the plants and the lawns in the evening, because water application during daytime will lead to more loss of water due to higher rate of evapo-transpiration.
- ☞ Improve water efficiency by using optimum amount of water in washing machine, dishwashers and other domestic appliances, etc.
- ☞ Install water saving toilets which use less water per flush.
- ☞ Check for water leaks in pipes and toilets and repair them promptly.
- ☞ Don't keep water taps running while they are not in use.
- ☞ Recycle water of washing of cloths for gardening.
- ☞ Installing rainwater harvesting structure to conserve water for future use.

Energy conservation for future use:

- ☞ Turn off all electric appliances such as lights, fans, televisions, computers, etc when not in use.
- ☞ Clean all the lighting sources regularly because dust on lighting sources decreases lighting levels up to 20-30%
- ☞ Try to harvest energy from natural resources to obtain heat for example drying the cloths in sun and avoid drying in washing machine.
- ☞ Save liquid petroleum gas (LPG) by using solar cookers for cooking.
- ☞ Design the house with provision for sunspace to keep the house warm and to provide more light.
- ☞ Avoid misuse of vehicles for transportation and if possible, share car journey to minimise use of petrol/diesel. For small distances walk down or just use bicycles.
- ☞ Minimise the use air conditioner to save energy.

Protect soil health:

- ☞ Use organic manure/compost to maintain soil fertility.
- ☞ To avoid soil erosion does not irrigate the plants by using fast flow of water.
- ☞ Use sprinkler irrigation to conserve the soil.
- ☞ Design landscape of lawn in large area which will help to bind soil to avoid erosion.
- ☞ Provide vegetation cover by growing of ornamental plant, herbs and trees in your garden.
- ☞ Use vegetable waste to prepare compost to use in kitchen gardening.

Promote sustainable agriculture:

- ☞ Diversify the existing cropping pattern for sustainability of agriculture.
- ☞ Cultivate need based crop.
- ☞ Maintain soil fertility.
- ☞ Make optimum use of fertilizers, pesticides and other chemicals for production and processing of agriculture products.
- ☞ Save grains in storage to minimise the losses.
- ☞ Improve indigenous breeds of milch animals for sustainable dairy production systems.
- ☞ Adopt post-harvest technologies for value addition.

Equitable Use of Resources for Sustainable Lifestyle

In last 50 years, the consumption of resource in the society has increased many folds. There is a big gap in the consumers lifestyle between developed and developing countries. Urbanisation has changed the life style of middle class population in developing countries creating more stress on the use of natural resources. It has been estimated that More Developed Countries (MDC) of the world constitute only 22% of world's population but they use 88% of natural resources. These countries use 73% of energy resources and command 85% of income and in turn they contribute very big proportion of pollution. On the other hand, less developed countries (LDCs) have moderate industrial growth and constitute 78% of world's population and use only 12% of natural resources, 27% of energy and have only 15% of global income.

There is a huge gap between rich and poor. In this age of development, the rich have gone richer, and the poor is becoming poorer. This has led to unsustainable growth. There is an increasing global concern about the management of natural resources. The solution to this problem is to have more equitable distribution of resources and income. Two major causes of unsustainability are over population in poor countries and over consumption of resources by rich countries. A global consensus has to be reached for balanced distribution of natural resources.

For equitable use of natural resources more developed countries/rich people have to lower down their level of consumption to bare minimum so that these resources can be shared by poor people to satisfy their needs. Time has come to think that it is need of the hour that rich and poor should make equitable use of resources for sustainable development of mankind.

UNIT-3
ECOSYSTEMS

The interaction and interrelationship between the living community (plants, animals, and organisms) in relation to each other and the non-living community (soil, air, and water) is referred to as an ecosystem. Thus, an ecosystem is a structural and functional unit of biosphere. It is made up of living and non-living beings and their physical environment.

In other words, a natural ecosystem is defined as a network of interactions among the organisms and between organisms and their environment. Nutrient cycles and energy flows keep these living and non-living components connected in an ecosystem.

Concept of an ecosystem:

Ecosystem - Scope and Importance

Ecosystem is a part of natural environment consisting of a community of living beings and the physical environment both constantly interchanging materials and energy between them. It is the sum total of the environment or a part of nature.

The environment consists of four segments as follows −

- **Atmosphere** − The atmosphere refers to the protective blanket of gases, surrounding the earth. It sustains life on the earth. It saves the Earth from the hostile environment of the outer space. The atmosphere composed of nitrogen and oxygen in large quantity along with small percentage of other gases such as argon, carbon dioxide, and trace gases (the gases which makes up less than 1 percent by volume of the atmosphere.
- **Hydrosphere** − Hydrosphere comprises all water resources such as ocean, seas, lakes, rivers, reservoirs, icecaps, glaciers, and ground water.
- **Lithosphere** − It is the outer mantle of the solid earth. It contains minerals occurring in the earth's crust and the soil.
- **Biosphere** − It constitutes the realm of living organisms and their interactions with the environment (atmosphere, hydrosphere, and lithosphere).

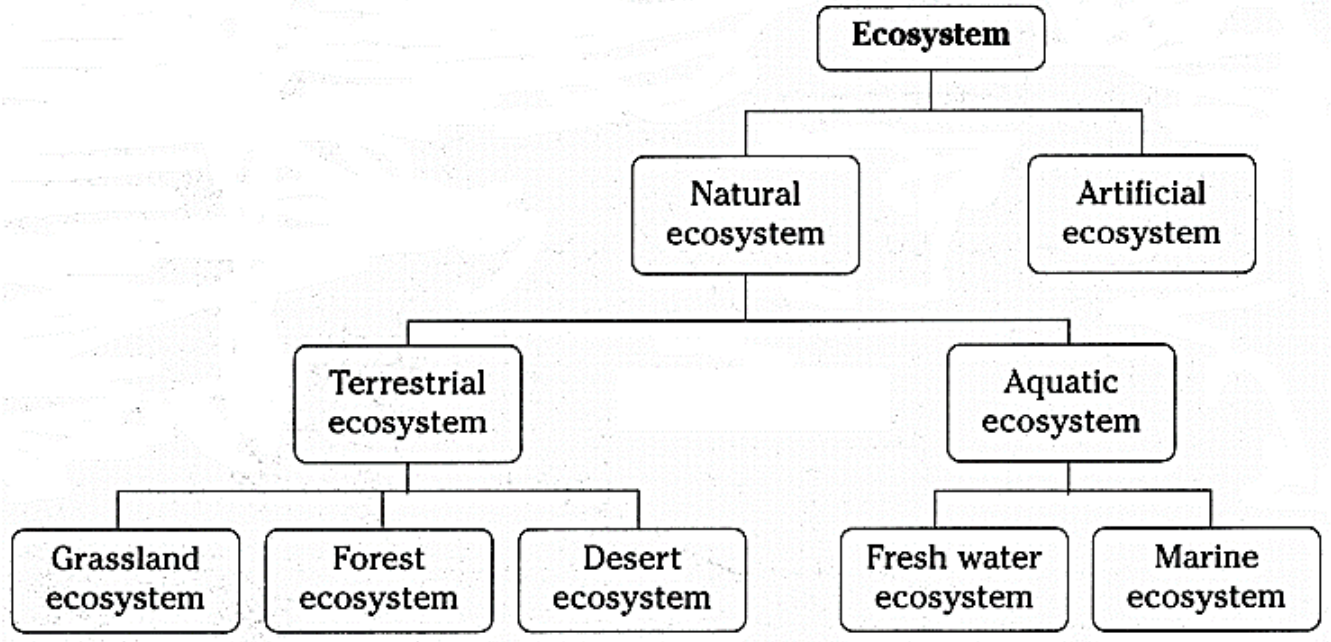
The study of ecosystem or environmental studies has been seen to be multidisciplinary in nature, hence, it is considered to be a subject with great scope. It is no more confined only to the issues of sanitation and health; rather, it is now concerned with pollution control, biodiversity conservation, waste management and conservation of natural resources.

The ecosystems are classified into many types and are classified based on a number of factors. We will discuss major types of ecosystems and will try and understand on what basis these classifications are done. It is also essential to know the different factors which differentiate the ecosystems from one another.

Ecosystems can generally be classified into two classes such as natural and artificial. **Artificial ecosystems** are natural regions affected by man's interferences. They are artificial lakes, reservoirs, townships, and cities.

Types of Ecosystems:

Flow chart of classification of ecosystem



Biotic (Living Components)

Biotic components in ecosystems include organisms such as plants, animals, and microorganisms. The biotic components of ecosystem comprise −

- Producers or Autotrophs
- Consumers or Heterotrophs
- Decomposers or Detritus

Abiotic (Non-living Components)

Abiotic components consist of climate or factors of climate such as temperature, light, humidity, precipitation, gases, wind, water, soil, salinity, substratum, mineral, topography, and habitat. The flow of energy and the cycling of water and nutrients are critical to each ecosystem on the earth. Non-living components set the stage for ecosystem operation.

Functions of Ecosystem:

The functional attributes of the ecosystem keep the components running together. Ecosystem functions are natural processes or exchange of energy that take place in various plant and animal communities of different biomes of the world.

For instance, green leaves prepare food and roots absorb nutrients from the soil, herbivores feed on the leaves and the roots and in turn serve as food for the carnivores.

Decomposers execute the functions of breaking down complex organic materials into simple inorganic products, which are used by the producers.

Fundamentally, ecosystem functions are exchange of energy and nutrients in the food chain. These exchanges sustain plant and animal life on the planet as well as the decomposition of organic matter and the production of biomass.

All these functions of the ecosystem take place through delicately balanced and controlled processes.

Trophic Levels in a Food Chain

Trophic levels are different stages of feeding position in a food chain such as primary producers and consumers of different types.

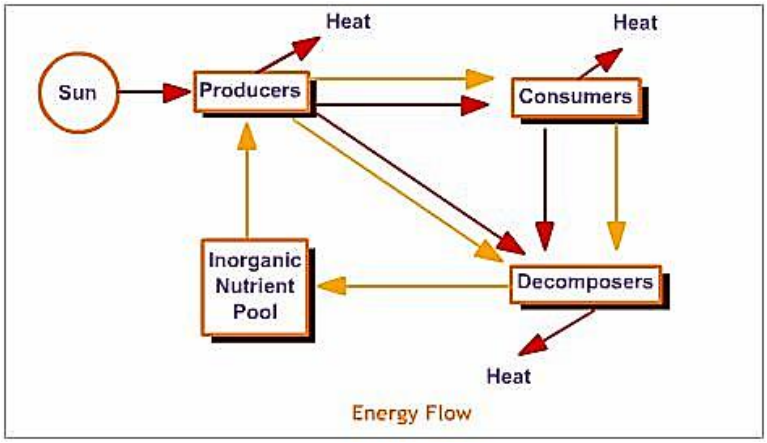
Organisms in a food chain are categorized under different groups called trophic levels. They are as follows.

1. **Producers (First Trophic Level)** − Producers otherwise called autotrophs prepare their food by themselves. They form the first level of every food chain. Plants and one-celled organisms, some types of bacteria, algae, etc. come under the category of Autotrophs. Virtually, almost all autotrophs use a process called photosynthesis to prepare food.
2. **Consumers** − At the second trophic level, there are consumers who depend upon others for food.
   - **Primary Consumers (Second Trophic Level)** − Primary consumers eat the producers. They are called herbivores. Deer, turtle, and many types of birds are herbivores.
   - **Secondary Consumers (Third Trophic Level)** − Secondary consumers based at the third trophic level eat plants and herbivores. They are both carnivores (meat-eaters) and omnivores (animals that eat both animals and plants). In a desert ecosystem, a secondary consumer may be a snake that eats a mouse. Secondary consumers may eat animals bigger than they are. Some lions, for example, kill and eat buffalo. The buffalo weighs twice as much as the lions do.
   - **Tertiary Consumers (Fourth Trophic Level)** − Tertiary consumers are animals eating other carnivores. The secretary bird in Africa and the King Cobra specialize in killing and eating snakes but all snakes are carnivores. The leopard seal eats mostly other carnivores - mainly other seals, squids, and penguins, all of which are carnivores.
3. **Decomposers** − Decomposers which don't always appear in the pictorial presentation of the food chain, play an important part in completing the food chain. These organisms break down dead organic material and wastes. Fungi and bacteria are the key decomposers in many ecosystems; they use the chemical energy in dead matter and wastes to fuel their metabolic processes. Other decomposers are detritivores—detritus eaters or debris eaters.

Understanding the food chain helps us know the feeding interrelationship and interaction between an organism and the ecosystem. It also enables us to know the mechanism of energy flow in an ecosystem.

Energy Flow in Ecosystem:

Energy moves life. The cycle of energy is based on the flow of energy through different trophic levels in an ecosystem. Our ecosystem is maintained by the cycling energy and nutrients obtained from different external sources. At the first trophic level, primary producers use solar energy to produce organic material through photosynthesis.



The herbivores at the second trophic level, use the plants as food which gives them energy. A large part of this energy is used up for the metabolic functions of these animals such as breathing, digesting food, supporting growth of tissues, maintaining blood circulation and body temperature.

The carnivores at the next trophic level, feed on the herbivores and derive energy for their sustenance and growth. If large predators are present, they represent still higher trophic level and they feed on

carnivores to get energy. Thus, the different plants and animal species are linked to one another through food chains.

Decomposers which include bacteria, fungi, moulds, worms, and insects break down wastes and dead organisms, and return the nutrients to the soil, which is then taken up by the producers. Energy is not recycled during decomposition, but it is released.

Ecological Succession:

Ecological succession is a term developed by botanists to describe the change in structure of a community of different species, or ecosystem. The concept of ecological succession arose from a desire to understand how large and complex ecosystems like forests can exist in places known to be recently formed, such as volcanic islands. The different types of ecological succession exists during different phases of an ecosystem, and depend on how developed that ecosystem is. In the concept of ecological succession, ecosystems advance until they reach a climax community. In the climax community, all of the resources are efficiently used and the total mass of vegetation maxes out. Many forests that have not been disturbed in many years are examples of a climax community.

Types of Ecological Succession

1. Primary Succession

When the planet first formed, there was no soil. Hot magma and cold water make hard rocks, as seen by newly formed islands. Primary ecological succession is the process of small organisms and erosion breaking down these rocks into soil. Soil is then the foundation for higher forms of plant life. These higher forms can produce food for animals, which can then populate the area as well. Eventually, a barren landscape of rocks will progress through primary ecological succession to become a climax community. After years and years, the soil layer increases in thickness and harbors many nutrients and beneficial bacteria that are required to support advanced plant life. If this primary ecosystem is disturbed and wiped out, secondary succession can take place.

2. Secondary Succession

The above graphic is an example of secondary ecological succession. The first picture displays a climax community. As the frames progress, the community is destroyed by a fire. As long as the fire does not burn hot enough to destroy the soil and the organisms it harbors, secondary ecological succession will take place. As seen in frame 5, small plants will come back first. After they create a solid layer of vegetation, larger plants will be able to take root and become established. At first, small shrubs and trees will dominate. As the trees grow, they will begin to block the light from most of the ground, which will change the structure of the species below the canopy. Eventually (frame 8), the ecosystem will arrive at a climax community, which may or may not be the similar to the original community. It all depends on which species colonize the area, and which seeds are able to germinate and thrive.

3. Cyclic Succession

Cyclic ecological succession happens within established communities and is merely a changing of the structure of the ecosystem on a cyclical basis. Some plants thrive at certain times of the year, and lay dormant the rest. Other organism, like cicadas, lay dormant for many years and emerge all at once, drastically changing the ecosystem.

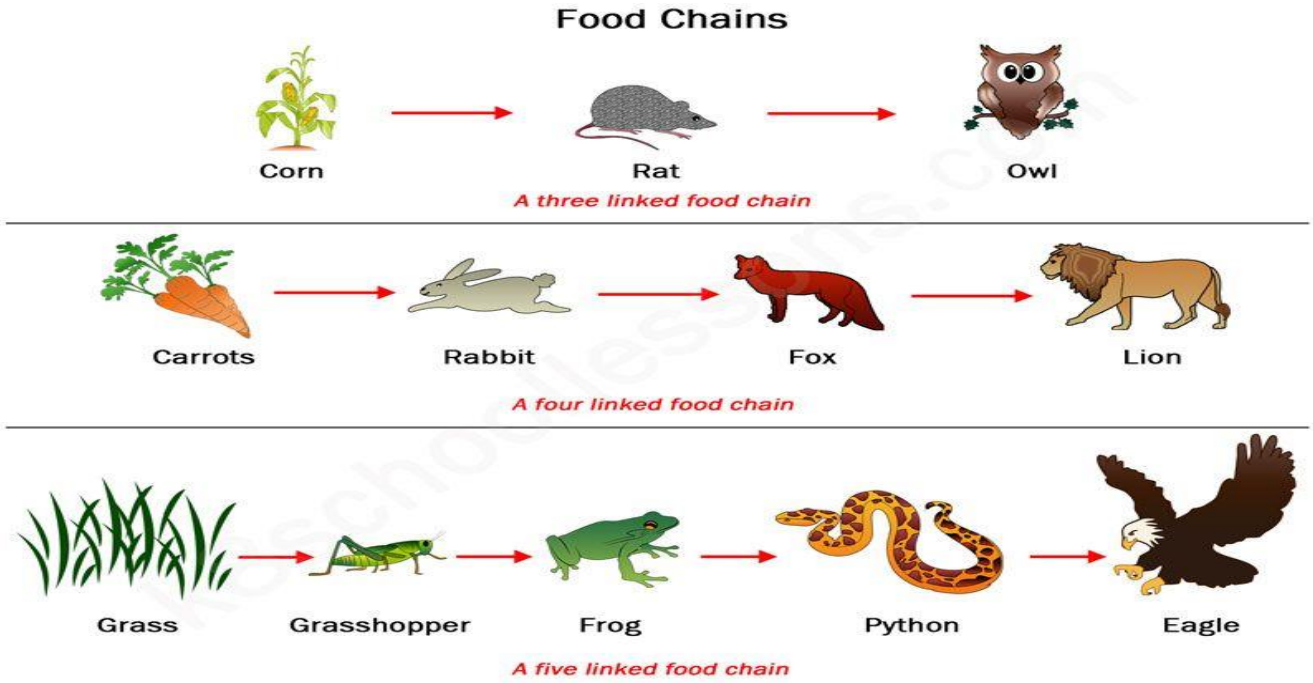
Food Chain

In scientific terms, a food chain is a chronological pathway or an order that shows the flow of energy from one organism to the other. In a community which has producers, consumers, and decomposers, the energy flows in a specific pathway. Energy is not created or destroyed. But it flows from one level to the other, through different organisms.

A food chain shows a single pathway from the producers to the consumers and how the energy flows in this pathway. In the animal kingdom, food travels around different levels. To understand a food chain better, let us take a look at the terrestrial ecosystem.

Example of food chain

Grass (Producer)→Goat (Primary Consumer) → Man (Secondary consumer)

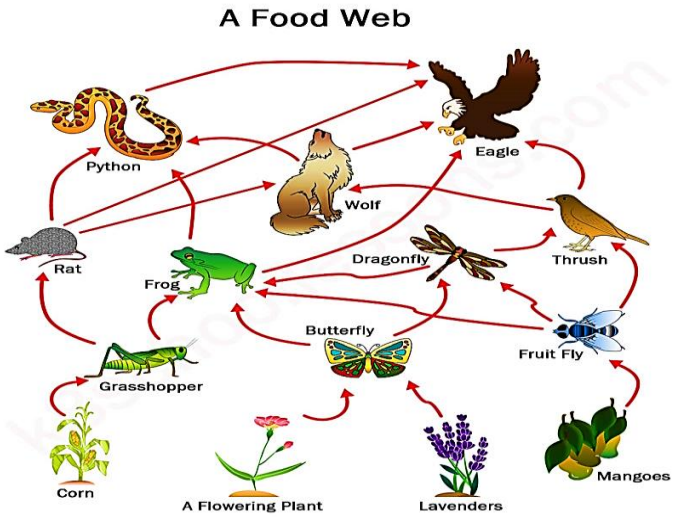


Food Web:

The word 'web' means network. Food web can be defined as 'a network of interconnected food chains so as to form a number of feeding relationships amongst different organism of a biotic community.

A food chain cannot stand isolated in an ecosystem. The same food resource may be a part of more than one chain. This is possible when the resource is at the lower tropic level.

A food web comprises all the food chains in a single ecosystem. It is essential to know that each living thing in an ecosystem is a part of multiple food chains.



A single food chain is the single possible path that energy and nutrients may make while passing through the ecosystem. All the interconnected and overlapping food chains in an ecosystem make up a food web. Food webs are significant tools in understanding that plants are the foundation of all ecosystem and food chains, sustaining life by providing nourishment and oxygen needed for survival and reproduction. The food web provides stability to the ecosystem.

The tertiary consumers are eaten by quaternary consumers. For example, a hawk that eats owls. Each food chain ends with a top predator and animal with no natural enemies (such as an alligator, hawk, or polar bear).

Ecological Pyramids:

Ecological Pyramid refers to a graphical (pyramidal) representation to show the number of organisms, biomass, and productivity at each trophic level. It is also known as Energy Pyramid. There are three types of pyramids. They are as follows −

Pyramid of Biomass

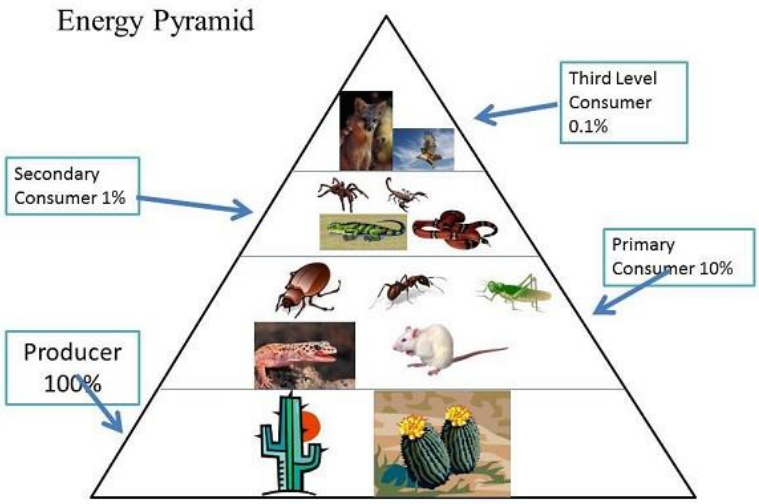
As the name suggests, the Biomass Pyramids show the amount of biomass (living or organic matter present in an organism) present per unit area at each trophic level. It is drawn with the producers at the base and the top carnivores at the tip.

Pyramid of biomass is generally ascertained by gathering all organisms occupying each trophic level separately and measuring their dry weight. Each trophic level has a certain mass of living material at a particular time called standing crop, which is measured as the mass of living organisms (biomass) or the number in a unit area.

Upright Pyramid of Biomass

Ecosystems found on land mostly have pyramids of biomass with large base of primary producers with smaller trophic level perched on top, hence the upright pyramid of biomass.

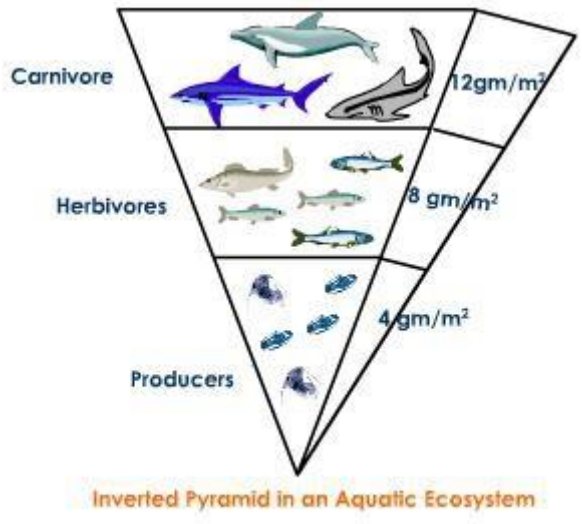
The biomass of autotrophs or producers is at the maximum. The biomass of next trophic level, i.e. primary consumers is less than the producers. Similarly, the other consumers such as secondary and tertiary consumers are comparatively less than its lower level respectively. The top of the pyramid has very less amount of biomass.



Inverted Pyramid of Biomass

On the other hand, a reverse pyramidal structure is found in most aquatic ecosystems. Here, the pyramid of biomass may assume an inverted pattern. However, pyramid of numbers for aquatic ecosystem is upright.

In a water body, the producers are tiny phytoplankton that grow and reproduce rapidly. In this condition, the pyramid of biomass has a small base, with the producer biomass at the base providing support to consumer biomass of large weight. Hence, it assumes an inverted shape.



Inverted Pyramid in an Aquatic Ecosystem

Pyramid of Numbers

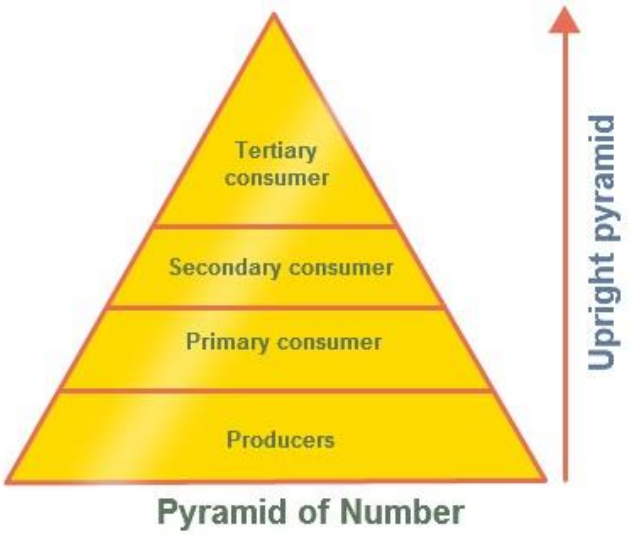
It is the graphic representation of number of individuals per unit area of various trophic levels. Large number of producers tend to form the base whereas lower number of top predators or carnivores occupy the tip. The shape of the pyramid of numbers varies from ecosystem to ecosystem.

For example, in an aquatic ecosystem or grassland areas, autotrophs or producers are present in large number per unit area. The producers support a lesser number of herbivores, which in turn supports fewer carnivores.

Upright Pyramid of Numbers

In upright pyramid of numbers, the number of individuals decreases from the lower level to the higher level. This type of pyramid is usually found in the grassland ecosystem and the pond ecosystem. The grass in a grassland ecosystem occupies the lowest trophic level because of its abundance.

Next comes the primary producers – the herbivores (for example – grasshopper). The number of grasshoppers is quite less than that of grass. Then, there are the primary carnivores, for example, the rat whose number is far less than the grasshoppers. The next trophic level is the secondary consumers such as the snakes who feed on the rats. Then, there are the top carnivores such as the hawks who eat snakes and whose number is less than the snakes. The number of species decreases towards the higher levels in this pyramidal structure.



Pyramid of Number

Inverted Pyramid of Numbers

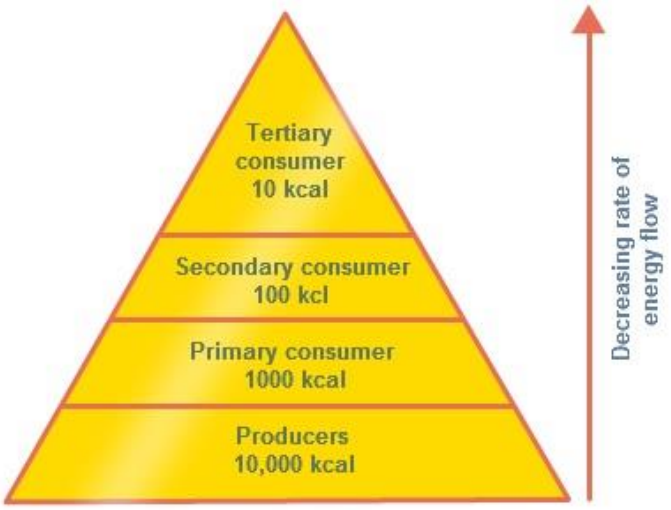
Here, the number of individuals increase from the lower level to the higher trophic level. For example, the tree ecosystem.

Pyramid of Energy

It is a graphical structure representing the flow of energy through each trophic level of a food chain over a fixed part of the natural environment. An energy pyramid represents the amount of energy at each trophic level and loss of energy at each is transferred to another trophic level.

Energy pyramid, sometimes called trophic pyramid or ecological pyramid, is useful in quantifying the energy transfer from one organism to another along the food chain.

Energy decreases as one moves through the trophic levels from the bottom to the top of the pyramid. Thus, the energy pyramid is always upward.



Pyramid of Energy

Forest Ecosystem:

A forest ecosystem is a functional unit or a system which comprises of soil, trees, insects, animals, birds, and man as its interacting units. A forest is a large and complex ecosystem and hence has greater species diversity.

Also, it is much more stable and resistant to the detrimental changes as compared to the small ecosystems such as wetlands and grasslands.

A forest ecosystem, similar to any other ecosystem, also comprises of abiotic and biotic components. Abiotic components refer to inorganic materials like air, water, and soil. Biotic components include producers, consumers, and decomposers.

These components interact with each other in an ecosystem and thus, this interaction among them makes it self-sustainable.

Structural Features of the Forest Ecosystem

The two main structural features of a forest ecosystem are:

1. **Species composition:** It refers to the identification and enumeration of the plant and animal species of a forest ecosystem.
2. **Stratification:** It refers to the vertical distribution of different species which occupy different levels in the forest ecosystem. Every organism occupies a place in an ecosystem on the basis of source of nutrition. For example, in a forest ecosystem, trees occupy the top level, shrubs occupy the second and the herbs and grasses occupy the bottom level.

Components of a Forest Ecosystem

The components of a forest ecosystem are as follows:

1. Productivity

The basic requirement for any ecosystem to function and sustain is the constant input of solar energy. Plants are also the producers in a forest ecosystem.

There are two types of productivity in a forest ecosystem, primary and secondary. Primary productivity means the rate of capture of solar energy or biomass production per unit area over a period of time by the plants during photosynthesis.

It is further divided into Gross Primary Productivity (GPP) and Net Primary Productivity (NPP). GPP of an ecosystem is the rate of capture of solar energy or the total production of biomass. However, plants also use a significant amount of GPP in respiration.

Thus, NPP is the amount of biomass left after the utilization by plants or the producers. We can hence say that NPP is the amount which is available for the consumption to herbivores and decomposers. Secondary productivity means the rate of absorption of food energy by the consumers.

2. Decomposition

Decomposition is an extremely oxygen-requiring process. In the process of decomposition, decomposers convert the complex organic compounds of detritus into inorganic substances such as carbon dioxide, water and nutrients.

Detritus is the remains of the dead plant such as leaves, bark, flowers and also the dead remains of the animals including their faecal matter. The steps involved in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralization.

In the process of fragmentation, detritivores break down the detritus into smaller particles. In the process of leaching, water-soluble inorganic nutrients descend down into the soil and settle as unavailable salts.

Under the process of catabolism, bacterial and fungal enzymes reduce detritus into simpler inorganic substances. Humification and mineralization processes take place during the decomposition of soil and not detritus.

The process of humification leads to the accumulation of humus which undergoes decomposition at a very slow rate. In the process of mineralization, the humus gets further degraded by microbes and inorganic nutrients are released.

3. Energy flow

Energy flows in a single direction. Firstly, plants capture solar energy and then, transfer the food to decomposers. Organisms of different trophic levels are connected to each other for food or energy relationship and thus form a food chain.

Energy Pyramid is always upright because energy flows from one trophic level to the next trophic level and in this process, some energy is always lost as heat at each step.

4. Nutrient Cycling

Nutrient cycling refers to the storage and movement of nutrient elements through the various components of the ecosystem. There are two types of Nutrient cycling, gaseous and sedimentary.

For Gaseous cycle (i.e. nitrogen, carbon), atmosphere or hydrosphere is the reservoir whereas for the sedimentary cycle (i.e. phosphorus) Earth's crust is the reservoir.

Aquatic Ecosystem

An aquatic ecosystem includes a group of interacting organisms which are dependent on one another and their water environment for nutrients and shelter. Examples of aquatic ecosystem include oceans, lakes and rivers.

An aquatic ecosystem includes freshwater habitats like lakes, ponds, rivers, oceans and streams, wetlands, swamp, etc. and marine habitats include oceans, intertidal zone, reefs, seabed and so on. The aquatic ecosystem is the habitat for water-dependent living species including animals, plants, and microbes.

1. Pond Ecosystem or Freshwater Aquatic Ecosystem:

They cover only a small portion of earth nearly 0.8 per cent. Freshwater involves lakes, ponds, rivers and streams, wetlands, swamp, bog and temporary pools. Freshwater habitats are classified into lotic and lentic habitats. Water bodies such as lakes, ponds, pools, bogs, and other reservoirs are standing water and known as lentic habitats. Whereas lotic habitats represent flowing water bodies such as rivers, streams.

- **Lotic Ecosystems**

They mainly refer to the rapidly flowing waters that move in a unidirectional way including the rivers and streams. These environments harbor numerous species of insects such as beetles, mayflies, stoneflies and several species of fishes including trout, eel, minnow, etc. Apart from these aquatic species, these ecosystems also include various mammals such as beavers, river dolphins and otters.

- Lentic Ecosystems

They include all standing water habitats. Lakes and ponds are the main examples of Lentic Ecosystem. The word lentic mainly refers to stationary or relatively still water. These ecosystems are home to algae, crabs, shrimps, amphibians such as frogs and salamanders, for both rooted and floating-leaved plants and reptiles including alligators and other water snakes are also found here.

- Wetlands

Wetlands are marshy areas and are sometimes covered in water which has a wide diversity of plants and animals. Swamps, marshes, bogs, black spruce and water lilies are some examples in the plant species found in the wetlands. The animal life of this ecosystem consists of dragonflies and damselflies, birds such as Green Heron and fishes such as Northern Pike.

2. Stream Ecosystem:

A stream is a general term as a small channel of freshwater that contains flowing water. They can be both natural and artificial. Many streams are "offshoots" of larger bodies of water like lakes or rivers. Natural streams are further classified as when they flow, where they flow from and if they are continuous.

Perennial streams flow all year long while seasonal streams are only seen at certain times of year, usually in wet season or as a result of snow or ice melting.

Continuous streams flow without stopping until they reach an endpoint or another body of water. Interrupted steams, on the other hand, may have breaks or different reaches depending on seasonality, barriers and other factors.

Abiotic Factors

Abiotic factors are defined as nonliving things that affect and shape an ecosystem. In a freshwater ecosystem like a stream, the following are going to be some of the most important abiotic factors:

- ✓ Temperature
- ✓ Sunlight levels
- ✓ pH level of the water
- ✓ Vitamins and minerals in the water
- ✓ Precipitation levels
- ✓ Water clarity
- ✓ Water chemistry

Chemistry of the water including pH levels along with abiotic nutrients in the water (minerals, chemicals, gases, etc.) are some of the most important factors in a freshwater ecosystem like a stream. Organisms depend on these nutrients in order to live, which is what will keep the stream a balanced and healthy community.

If pH levels are changed, nutrients become imbalanced, pollutants/toxins enter, light levels decrease or if there are any other changes to these abiotic factors, the organisms that have adjusted to their stream environment will no longer be able to survive. This will cause a chain reaction of organismal death and further imbalance of the abiotic factors and the ecosystem overall.

Biotic Factors

Biotic factors are all of the living things and factors within an ecosystem. This includes things as tiny as microscopic bacteria found at the banks of the stream to the huge bears that hunt for fish in the stream's water.

According to the U.S. Geological Survey, there are three key and dominant biotic factors that make up a stream ecosystem: fish, invertebrate species and algae.

Biotic Factor: Algae

Algae is perhaps the most important biotic factor since these autotrophs are responsible for turning the sun's energy that penetrates the water's surface into usable chemical energy and biomass via photosynthesis.

Without this freshwater algae, there would be no way for energy to enter the ecosystem. Other primary producers can exist in these ecosystems as well including trees along the banks, water lilies, duckweed, cattails and more.

Invertebrate Species

Invertebrate species that are important to freshwater ecosystems like streams generally include segmented worms and arthropods. Some specific examples include the common earthworm, leeches, water beetles, mayflies, dragonflies, mussels and more.

Fish Species

Fish species are another critical biotic factor that make up stream communities. These fish will eat both the algae and the invertebrate species in the water. They'll also provide food for larger fish as well as other organisms in surrounding communities like bears and foxes.

Other animal species common in streams include crayfish, spiders, frogs, water snakes and bird species (ducks, kingfishers, etc). Other organisms like plankton and various species of protists are also biotic factors relevant in a stream ecosystem.

Marine ecosystem covers the largest surface area of the earth. Two third of earth is covered by water and they constitute of oceans, seas, intertidal zone, reefs, seabed, estuaries, hydrothermal vents and rock pools. Each life form is unique and native to its habitat. This is because they have adaptations according to their habitat. In the case of aquatic animals, they can't survive outside of water. Exceptional cases are still there which shows another example of adaptations (e.g. mudskippers). The marine ecosystem is more concentrated with salts which make it difficult for freshwater organisms to live in. Also, marine animals cannot survive in freshwater. Their body is adapted to live in saltwater; if they are placed in less salty water, their body will swell (osmosis).

River Ecosystem:

The ecology of the river refers to the relationships that living organisms have with each other and with their environment – the ecosystem. An ecosystem is the sum of interactions between plants, animals and microorganisms and between them and non-living physical and chemical components in a particular natural environment.

River ecosystems have:

- flowing water that is mostly unidirectional
- a state of continuous physical change
- many different (and changing) microhabitats
- variability in the flow rates of water
- plants and animals that have adapted to live within water flow conditions.

Water flow

Water flow is the main factor that makes river ecology different from other water ecosystems. This is known as a lotic (flowing water) system. The strength of water flow varies from torrential rapids to slow backwaters. The speed of water also varies and is subject to chaotic turbulence. Flow can be affected by sudden water input from snowmelt, rain and groundwater. Water flow can alter the shape of riverbeds through erosion and sedimentation, creating a variety of changing habitats.

Substrate

The substrate is the surface on which the river organisms live. It may be inorganic, consisting of geological material from the catchment area such as boulders, pebbles, gravel, sand or silt, or it may be organic, including fine particles, leaves, wood, moss and plants. Substrate is generally not permanent and is subject to large changes during flooding events.

Light

Light provides energy for photosynthesis, which produces the primary food source for the river. It also provides refuges for prey species in the shadows it casts. The amount of light received in a flowing waterway is variable, for example, depending on whether it's a stream within a forest shaded by overhanging trees or a wide exposed river where the Sun has open access to its surface. Deep rivers tend to be more turbulent, and particles in the water increasingly weaken light penetration as depth increases.

Temperature

Water temperature in rivers varies with the environment. Water can be heated or cooled through radiation at the surface and conduction to or from the air and surrounding substrate. Temperature differences can be significant between the surface and the bottom of deep, slow-moving rivers. Climate, shading and elevation all affect water temperature. Species living in these environments are called poikilotherms – their internal temperature varies to suit their environmental conditions.

Water chemistry

The chemistry of the water varies from one river ecosystem to another. It is often determined by inputs from the surrounding environment or catchment area but can also be influenced by rain and the addition of pollution from human sources.

Oxygen is the most important chemical constituent of river systems – most organisms need it for survival. It enters the water mostly at the surface, but its solubility decreases as the water temperature increases. Fast, turbulent waters expose a wider water surface to the air and tend to have lower temperatures – achieving more oxygen input than slow backwaters. Oxygen is limited if water circulation is poor, animal activity is high or if there is a large amount of organic decay in the waterway.

Bacteria

Bacteria are present in large numbers in river waters. They play a significant role in energy recycling. Bacteria decompose organic material into inorganic compounds that can be used by plants and by other microbes.

Plants

Plants photosynthesise – converting light energy from the Sun into chemical energy that can be used to fuel organisms' activities.

Algae are the most significant source of primary food in most rivers or streams. Most float freely and are therefore unable to maintain large populations in fast-flowing water. They build up large numbers in slow-moving rivers or backwaters. Some algae species attach themselves to objects to avoid being washed away.

Plants are most successful in slower currents. Some plants such as mosses attach themselves to solid objects. Some plants are free-floating such as duckweed or water hyacinth. Others are rooted in areas of reduced current where sediment is found. Water currents provide oxygen and nutrients for plants. Plants protect animals from the current and predators and provide a food source.

Invertebrates

Invertebrates have no backbone or spinal column and include crayfish, snails, limpets, clams and mussels found in rivers. A large number of the invertebrates in river systems are insects. They can be found in almost every available habitat – on the water surface, on and under stones, in or below the substrate or adrift in the current. Some avoid high currents by living in the substrate area, while others have adapted by living on the sheltered downstream side of rocks. Invertebrates rely on the current to bring them food and oxygen. They are both consumers and prey in river systems.

Fish

The ability of fish to live in a river system depends on their speed and duration of that speed – it takes enormous energy to swim against a current. This ability varies and is related to the area of habitat the fish may occupy in the river. Most fish tend to remain close to the bottom, the banks or behind obstacles, swimming in the current only to feed or change location. Some species never go into the current. Most river systems are typically connected to other lotic systems (springs, wetlands, waterways, streams, oceans), and many fish have life cycles that require stages in other systems. Eels, for example, move between freshwater and saltwater. Fish are important consumers and prey species.

Birds

A large number of birds also inhabit river ecosystems, but they are not tied to the water as fish are and spend some of their time in terrestrial habitats. Fish and water invertebrates are an important food source for water birds.

Ocean Ecosystems

Our planet earth is gifted with the five major oceans, namely Pacific, Indian, Arctic, and the Atlantic Ocean. Among all these five oceans, the Pacific and the Atlantic are the largest and deepest ocean. These

oceans serve as a home to more than five lakh aquatic species. Few creatures of these ecosystems include shellfish, shark, tube worms, crab small and large ocean fishes, turtles, crustaceans, blue whale, reptiles, marine mammals, seabirds, plankton, corals and other ocean plants.

- **Coastal Systems**

They are the open systems of land and water which are joined together to form the coastal ecosystems. The coastal ecosystems have a different structure, and diversity. A wide variety of species of aquatic plants and algae are found at the bottom of the coastal ecosystem. The fauna is diverse and it mainly consists of crabs, fish, insects, lobsters snails, shrimp, etc.

Plants and animals in an aquatic ecosystem show a wide variety of adaptations which may involve life cycle, physiological, structural and behavioural adaptations. Majority of aquatic animals are streamlined which helps them to reduce friction and thus save energy. Fins and gills are the locomotors and respiratory organs respectively. Special features in freshwater organisms help them to drain excess water from the body. Aquatic plants have different types of roots which help them to survive in water. Some may have submerged roots; some have emergent roots or maybe floating plants like water hyacinths.

Estuaries Ecosystem:

Places where fresh water streams or rivers connect with salt water from the sea or oceans is called an estuary. Mixing of freshwater from rivers and salt water in oceans creates a unique ecosystem.

- Estuaries contain high amount of nutrients.
- Microflora (algae) and macroflora (seaweeds, marsh grass and mangrove trees) are found in estuaries.
- Estuaries support diverse fauna like oysters, crabs and waterfowl.
- Net Primary Productivity of estuaries is very high (200 - 300 g/m2)
- High productivity of estuaries is because of the large amounts of nutrients that enter the basin from rivers flowing into it.

Characteristics of estuaries:

- Water is moderately salty in this region.
- Estuaries contain rich sediments that are carried by river water and form SHOALS and MUD FLATS that nurture a multitude of aquatic life.
- Estuaries are not affected by ocean action. They experience tidal waves and flows which cause rise and fall in river water level at some distance from the river mouth.
- The productivity of estuarine ecosystem is high.
- Species diversity is high.
- Delta regions are biologically rich because of steady flow of nutrients into estuaries ESTUARINE ECOSYSTEM.
- Estuaries are transition zones that are strongly affected by tides of the sea.
- Water characteristics change periodically.
- Living organisms in estuarine ecosystems have wide tolerance.
- Salinity in estuarine water is high during summer and lest during winter.

An estuary is a partially enclosed coastal area at the mouth of a river where sea water mixes with fresh water. It is strongly affected by tidal action. Estuaries are usually nutrients in abundance. Estuaries are useful to human beings due to their high food potential. Hence, estuaries must be protected from pollution.

Structure and Function:

Abiotic components

Temperature, pH, sodium and potassium salts and various nutrients.

Biotic components

1. Producers: Ex - Marsh grass, sea-weeds, sea-grass and phytoplankton
2. Consumers: Ex - Oysters, Crabs, Seabirds and small fish
3. Decomposers: Ex - Bacteria, Fungi and actinomycetes

UNIT- 04

Biodiversity and its Conservation

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

Genetics is the study of how traits such as hair colour, eye colour, and risk for disease are passed ("inherited") from parents to their children. **Genetics** influence how these inherited traits can be different from person to person.

A **species** is a group of organisms that share a genetic heritage, are able to interbreed, and to create offspring that are also fertile.

Ecosystem diversity deals with the variations in ecosystems within a geographical location and its overall impact on human existence and the environment. Ecological diversity is a type of biodiversity. It is the variation in the ecosystems found in a region or the variation in ecosystems over the whole planet.

BIOGEOGRAPHIC CLASSIFICATION OF INDIA:

Our country can be divided into ten major regions based on the geography,
climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibians, insects and other invertebrates that live in them. Each of these regions contain a variety of ecosystems such as forests, grass lands, lakes, rivers, mountains, and hills which have specific plant and animals' species.

India's Biogeographic Zones are given below:

1. The cold mountainous snow-covered Trans-Himalayan region of Ladakh.
2. The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam, and other North-eastern States.
3. The Terai, the low land where the Himalayan rivers flow into the plains.
4. The Gangetic and Brahmaputra plains.
5. The Thar Desert of Rajasthan.
6. The semi- arid grassland region of the Deccan plateau, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamilnadu.
7. The North-eastern States of India.
8. The Western Ghats in Maharashtra, Karnataka, and Kerala.
9. The Andaman and Nicobar Islands.
10. The long western and eastern coastal belt with sandy beaches, forests, and mangroves.

Value of biodiversity:

Biodiversity provides a variety of environmental services from its species and ecosystems that are essential at the global, regional and local levels. Biodiversity is essential for preserving ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support, maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction. Food, clothing, housing, energy, medicines are all resources that are directly or indirectly linked to the biological variety present in the biosphere.

Consumptive use value: A straight consumptive use is the direct utilization of timber, food, fuelwood and fodder by local communities. The diversity of organisms provide food, clothing, shelter, medicines, proteins, enzymes, papers, sports goods, musical instruments, beverages, narcotics, pets, zoo specimens, tourism, and raw material for business prospects etc.

Productive use value: This category comprises of marketable goods. The biotechnologist uses bio-rich areas to prospect and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops for use in farming and plantation programs or to develop better livestock. To the pharmacist, biological diversity is the raw material from which new drugs can be identified from plant or

animal products. To industrialists, biodiversity is rich storehouse from which to develop new products. For the agricultural scientist, the biodiversity is the basis for developing better crops. A variety of industries, like pharmaceuticals are highly dependent on identifying compounds of great economic value from the wide variety of wild species of plants located in undisturbed natural forests called "biological prospecting".

Social values: Social value of biodiversity prospecting motivated habitat conservation in some areas, as traditional societies valued it as a resource. Ecosystem people value biodiversity as a part of their livelihood as well as through cultural and religious sentiments. A great variety of crops have been cultivated in traditional agricultural systems and permitted a wide range of produce to be grown and marketed throughout the year and acted as an insurance against the failure of one crop. In recent years, farmers have begun to receive economic incentives to grow cash crops for national or international markets, rather than to supply local needs. This has resulted in local food shortages, unemployment, landlessness, and increased vulnerability to drought and floods.

Ethical and moral values: Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life against illegal activities like cloning of animals, smuggling of valuable biodiversity instances, bio-piracy, illicit trade etc. In India, several generations have preserved nature through local traditions. However, immediate benefit rather than ethics appears to be modern man's objective.

Aesthetic value: Biodiversity is a direct source of pleasure and aesthetic satisfaction – its contribution to quality of life, outdoor recreation and scenic enjoyment. They provide opportunities for recreational activities such as hiking, canoeing, bird watching, river rafting, rock climbing, trekking, parasailing, bird watching and nature photography. The designing of thousands of new horticultural species, wild life conservation, landscape luxury, national parks, zoological and botanical gardens, snake, crocodile, butterfly parks, and biotechnologically manipulated novel curios species added to the existing aesthetics.

Option value: Keeping future possibilities open for their use is called 'option value'. It is impossible to predict which of our species or traditional varieties of crops and domestic animals will be of greatest use in the future. Important ecosystem services and uses for plants and animals are still unknown and await discovery. It becomes valuable if targets are based on policy of obtaining wealth from wastes.

Biodiversity at Global, National and Local Levels:

Global Level:

Conservative estimates of the existing biodiversity is ten million species, but if estimates for insects are correct then it could be around 30 million species, we have till now enlisted about 1.4 million species. It includes among others about 98% birds, 95% reptiles and amphibians, 90% fish and about 85% higher plants known to exist on this Earth (Table 4.1)

National and Local Level:

India has over 108,276 species of bacteria, fungi, plants and animals already identified and described (Table 4.2). Out of these, 84 percent species constitute fungi (21.2 percent), flowering plants (13.9 percent), and insect (49.3 percent). In terms of the number of species, the insecta alone constitute nearly half of the biodiversity in India (Fig 4.1).

These species occur on land, fresh and marine waters, or occur as symbionts in mutualistic or parasitic state with other organisms. In the world as a whole, 16, 04,000 species of Monera, Protista, Fungi, Plantae and Animalia have been described so far. However, it is estimated that at least 179, 80,000 species exist in the world, but as a working figure 122, 50,000 species are considered to be near reality.

Percentage of Different Biota in India

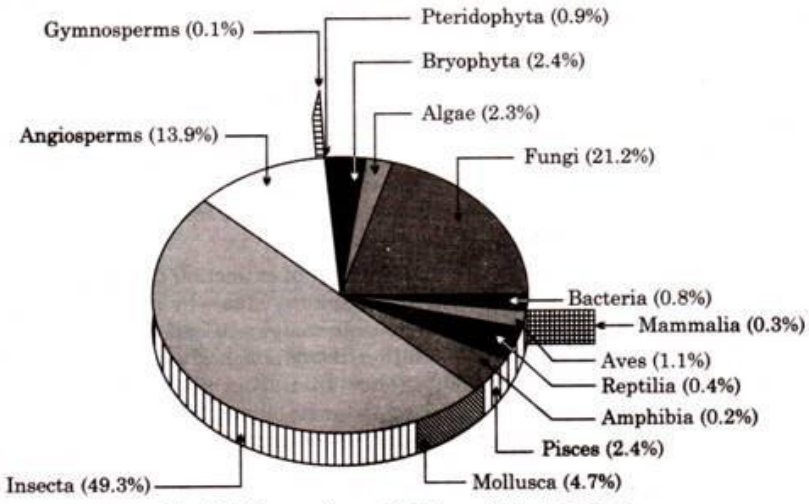


Fig. 4.1. Percentage of Different Biota in India.

Table 4.2 : Number of Species of Bacteria, Fungi, Plants and Animals

Taxon	Number of Species	Percentage
Bacteria	850	0.8
Fungi	23,000	21.2
Algae	2,500	2.3
Bryophyte	2,564	2.4
Pteridophyta	1,022	0.9
Gymnosperms	64	0.1
Angiosperms	15,000	13.9
Insecta	53,430	49.3
Mollusca	5,050	4.7
Pisces	2,546	2.4
Amphibian	204	0.2
Reptilia	446	0.4
Aves	1,228	1.1
Mammalian	372	0.3
Total	108,276	100.00

India is 10th among the plant rich countries of the world, fourth among the Asian countries, eleventh according to the number of endemic species of higher vertebrates (amphibia, birds and mammals), and tenth in the world as far as richness in mammals is concerned. Out of the 10 'Hot spots' identified in the world; India has four. These are Eastern Himalaya, North-East India, Western Ghats and Andaman & Nicobar Islands.

The crops which first grew in India and spread throughout the world include rice, sugarcane, Asiatic vignas, jute, mango, citrus, and banana, several species of millets, spices, medicinal, aromatics and ornamentals. India ranks sixth among the centres of diversity and origin in terms of agro-biodiversity.

Threats to Biodiversity

Habitat Loss

Today, major loss to biodiversity in the world has been done by man. Man has begun to overuse or misuse most of these natural ecosystems.

Due to mindless and unsustainable resource use, once productive forest and grasslands have been turned into deserts, and wastelands have increased all over the world. Rapid industrialization, urbanization, and growth in population have resulted in massive deforestation and consequential habitat loss around the world.

For instance, mangroves have been cleared for fuelwood and prawn farming, which has led to a decrease in the habitat essential for breeding of marine fish.

Forests all over the world, in particular tropical rainforests such as the Amazon, are under unforeseen threat largely from conversion to other land-uses.

Scientists have estimated that human activities are likely to eliminate approximately10 million species by the year 2050. It is also estimated that at the present rate of extinction about 25 percent of the world's species will undergo extinction rapidly. Rich biodiversities such as tropical forests, wetlands, and coral reefs world over will constitute a major part of this extinction.

Poaching of Wildlife

Poaching of wildlife for trade and commercial activities has been on the rise for the last many decades. It has been a significant cause of the extinction of hundreds of species and the endangerment of many more, such as whales and many African large mammal, Asian tigers, etc. Most extinction over the past several hundred years is mainly due to overharvesting for food, fashion, and profit.

Illicit trade in wildlife in current times is driving many species of wild animals and plants to extinction. Elephants are poached for ivory; tigers and leopards for their skin; pangolins for meat and scales; and rare timber is targeted for hardwood furniture.

The global illegal wildlife trade is estimated to be between $7 billion and $23 billion in illicit revenue annually. It is now considered the most lucrative global crime after drugs, humans, and arms.

In 2015, the United Nations General Assembly unanimously adopted a resolution for tackling illicit trafficking in wildlife. The Sustainable Development Goals has laid down specific targets to combat poaching and trafficking of protected species.

Man-Wildlife Conflict

Man-wildlife conflict refers to the interaction between wild animals and people and the consequential negative impact on both of them. Human population growth and the resultant destruction of wildlife habitat for human habitation and economic prosperity create reduction of resources or life to some people and wild animals.

Worldwide Fund for Nature (WWF) defines this conflict as "any interaction between humans and wildlife that results in a negative impact on human social, economic, or cultural life, on the conservation of wildlife population, or on the environment."

Although man-wildlife conflict is as old as human civilization, in modern times the degree of conflict has been on the rise due to high rise in human population in the past several centuries.

Since human populations expand into wild animal habitats, natural wildlife territory is displaced. Reduction in the availability of natural prey/food sources leads to wild animals seeking alternate sources. Alternately, new resources created by humans draw wildlife resulting in conflict. Competition for food resources also occurs when humans attempt to harvest natural resources such as fish and grassland pasture.

There are many consequences of man versus wildlife conflicts. The major consequences are −

- Destruction of wildlife habitat
- Injury and loss of life of both humans and wildlife
- Crop damage and livestock depredation
- Damage to human property
- Decrease in wildlife population and reduction in geographic ranges
- Trophic cascades

Apart from the above, there are other causes of threat to biodiversity. Factors such as climate change, invasion of non-native species also add to biodiversity losses in some or the other.

Considering the degree of threat to biodiversity around the world and the vital importance of biodiversity for living beings of which mankind is a major part, there is an urgent need to conserve biodiversity in the world. Further, we should be concerned about saving biodiversity because of the benefits it provides us – biological resources and ecosystem services, and the social and aesthetic benefits.

There are two main methods for the conservation of biodiversity.

In-situ Conservation

In-situ or on-site conservation refers to the conservation of species within their natural habitats. This is the most viable way of biodiversity conservation. It is the conservation of genetic resources through their maintenance within the environment in which they occur.

Examples − National Parks, Wildlife sanctuaries, Biosphere Reserves, Gene Sanctuaries

Ex-situ Conservation

Ex-situ conservation means the conservation of components of biological diversity outside their natural habitats. In this method, threatened or endangered species of animals and plants are taken out of their natural habitat and placed in special settings where they can be protected and provided with natural growth.

In ex-situ conservation methods, the plants and animals taken away from their habitats are taken care of in an artificially created environment.

Examples − Captive Breeding, Gene Banks, Seed Banks, Zoos, Botanical gardens, Aquaria, In vitro fertilization, Cryopreservation, Tissue Culture.

National Biodiversity Act

National Biodiversity Act in India draws from the objectives of Convention of Biodiversity (CBD). It aims at conservation of biodiversity, sustainable use and equitable sharing of the benefits of such use.

To achieve its objectives, it has put in place a three-tier institutional structure such as −

- National Biodiversity Authority based in Chennai
- State Biodiversity Board (SBBs) in every state
- Biodiversity Management Committee (BMCs) at Panchayat/Municipality levels

UNIT – 05
POLLUTION
AIR POLLUTION

Air pollution is defined as "the addition of undesirable foreign materials into the atmosphere which adversely affect the quality of air."

The four major air pollutants are as follows:

1. Gases
2. Particulates
3. Internal combustion engine
4. Deforestation

1. Gases:

Various gaseous pollutants such as CO, CO2, NO, NO2, SO2, SO2, HF, alkanes, alkenes, alkynes etc. pollute air to a great extent.

Sources and effect of CO:

About two-third of the CO emitted are from the internal combustion engines. Intake of excess of CO may cause blindness or may be proved fatal. This is because of the formation of carboxy-haemoglobin (Hb –CO) in blood.

Sources and effect of CO_2:

The major sources of CO_2 are burning of fossil fuel and human respiration. Increase in concentration of CO_2 in the atmosphere onset the disastrous global warming process, which would lead to the melting of polar ice caps and ultimately lead to the increase in the level of sea water.

Sources and effect of sulphur dioxide (SO_2):

SO_2 gas is mainly emitted from thermal power plants, oil refineries, petroleum industries, sulphuric acid plants etc. This pollutant causes heart and respiratory diseases to human and damages agriculture. SO_2 also damages cell membrane, chlorophyll of plants. Also, it inhibits metabolism and plant growth.

Sources and effect of sulphur trioxide (SO_3) :

It is generated by the action of air on SO_2 gas in presence of sunlight. It causes breathing discomfort and irritation to the respiratory tract.

Sources and effect of hydrogen sulphide (H_2S) :

It is produced by the decomposition of sewage wastes and organic matters. It is highly toxic. It corrodes metals and spoils the lead paintings or exterior finishing of buildings.

Sources and effect of Oxides of nitrogen:

These are normally produced by the incomplete combustion of fuels used in internal combustion engines. Acid manufacturers and explosive industries are also the sources of these toxic gases. It affects respiratory tracts, lungs and eyes.

Sources and effect of aerosols:

These pollutants are generally added into the atmosphere by the jet planes. The propellants used in jet planes contain chlorofluorocarbons (CFCs) which when exposed to atmosphere causes depletion of ozone layer.

Sources and effect of hydrocarbons:

The major sources of hydrocarbons such as methane, ethane, benzene, toluene, ethers etc. are research laboratories. Methane gas is also produced in damp area. Aromatic hydrocarbons are more toxic and cause respiratory problem, lung cancer etc.

2. PARTICULATES:

Small solid particles and liquid droplets suspended in air are collectively called particulates.

Smoke: Smoke consists of small soot particles. Smoke spoils clothes, exterior finishing of buildings. Also it may cause lung cancer.

Dust: Dust denotes the fine particles producing during certain industrial process that is crushing, grinding. It consists of limestone, sand, cement, fly ash, silica dust etc. It causes allergic and respiratory diseases.

Asbestos: It is a fibrous silicate mineral which causes asbestosis (a lung's disease) in children and cancer.

Smog: Smog is a mixture smoke and fog in suspended droplet form. It causes irritation to eyes, bronchial irritation. It also causes acid rain to occur.

Lead: It causes anaemia by inhibiting the enzymes that catalyse the reaction for the biosynthesis of haemoglobin. It damages the central nervous system, kidney and brain.

Mercury: Mercury in its vapours from if inhaled causes damages to lung tissue which leads to cancer.

Cadmium: It causes the disease itai-itai, anaemia, bone marrow disorders.

3. DEFORESTATION:

Due to the rapid growth of population and industrialization a large number of trees are being cut. This leads to the increasing in the concentration of CO2 gas in the atmosphere. The CO2 level needs to be controlled in view of the possible of onset of the disastrous global warming process.

4. INTERNAL COMBUSATION ENGINE:

Internal combustion engines in which petroleum products are used as fuel, releases a huge quantity of nitric oxide (NO) and carbon monoxide (CO) into the atmosphere. These gases besides their contribution towards acid rain, causes many diseases which badly effect respiratory tract, eye vision etc.

METHODS FOR THE CONTROL OF AIR POLLUTION:

The following controlling measures may be advised for the control of air pollution such as:

i. Catalytic converters should be used in vehicles to reduce the quantity of toxic exhaust.
ii. The height of chimneys should be increased, so that most of the gaseous pollutants go far off the lower atmospheric region.
iii. Cyclone collector should be used in industries, so that particulates get settled. The machine operates on the principle that particulates present in a gaseous stream have greater inertia than those of gas molecules.
iv. Cottrell Electrostatic precipitators (ESP) should be used in the chimneys of every industry to reduce smoke.
v. Fossil fuel should be de-sulphurised to reduce pollution due to SO2 and SO3 gases.
vi. Quantity of smoke can be reduced in internal combustion engines by a admitting accurate mixture of fuel and air (b) feeding the fuel continuously (c) proper tuning of engines.
vii. Non-conventional sources of energy [solar energy, tidal energy etc] should be preferred over conventional sources such as fossil fuel.
viii. There should be a proper "industrial zoning" to avoid air pollution.
ix. A forestation should be made.
x. Awareness regarding air pollution must be created amongst the public through various demonstrations, public meetings, etc.
xi. Air pollution act should be revised by the Government from time to time and they should be properly implemented.

GREEN HOUSE EFFECT:

The global phenomenon by which the temperature of the surface of earth is increasing day by day like the mercury column of a thermometer is called Global warming. It is the major global concern and threat to the globe now -a- days.

The phenomenon is like that of green house in which the glass enclosed atmosphere gets heated up due to its insulation from the rest of the environment. The gases such as CO2, CH4, CFCs, and water vapours called Greenhouse gases absorb a considerable portion of solar radiation which keeps the earth in a warmth condition, so that the life process is sustained. But, due to the rapid growth of industrialization and population, the concentrations of these gaseous substances are rapidly increasing. Thus, a large fraction of IR radiations and heat waves are absorbed by these gases which help in rising the temperature of the surface of earth.

Consequences of Green House Effect:

i. If the rate at which solar radiation are arriving the earth remains constant but the amount of CO2 in the air increases (due to human activities), the heat radiated back to the earth (by CO2 and H2 O molecules) will increase. Consequently, the temperature of the earth's surface will increase.

ii. Higher global temperature is likely to increase the incidence of infectious diseases like malaria, dengue, yellow fever and sleeping sickness.

iii. Due to global warming, the polar ice caps and glaciers are melting down and the level of sea water is increasing day by day. Also, it is reported by a reputed science journal that, a large gap of about half kilometre is seen in the ice bergs of North Pole. A time will come when the whole earth will be submerged in water. A part of the earth will face drought while the other part will face flood.

iv. A recent research has revealed that global warming will invite the "Ice Age" to come.

Water Pollution and its Effect on Human Health

Water is one of the basic needs of household, agriculture, and industry. For most of the purposes, e.g. drinking, washing etc. we need pure and clean water. However, the natural water gets contaminated or polluted in the following two ways:

A. By natural processes, that is washing away of the decomposed vegetable and animal wastes into the mainstream of water.
B. By human activity (anthropogenic processes), that is discharge of industrial effluents, domestic wastes, use of pesticides and fertilizers etc.

Water pollution may be defined as "Any change in the physical, chemical and biological properties of water, due to the addition of foreign substances to the water body which would constitute a health hazard or otherwise decreases the utility of water."

Sources of water pollution: Various sources of water pollution are described below:

1. **Industrial effluents:** Different industries such as, paper, textile, cement, paints etc, release various kinds of waste products directly into the water bodies. This causes serious water pollution.
2. **Domestic Sewage:** Garbage, human faeces etc. are sent into sewage, where they are carried out in to canals and rivers, thereby causing water pollution.
3. **Agricultural discharge:** The unutilized fertilizers, pesticides, fungicides etc. along with plant and animal debris of agricultural fields are finally carried out by rainwater to various canals and rivers which pollute water.
4. **Run-off from urban area:** In town and cities various kinds of waste materials are released from hotels, hospitals, shops, workshops etc. These waste materials are washed off by rainwater which causes pollution in water bodies.

5. **Suspended particulates:** Water gets polluted due to the presence of a large concentration of suspended particles and other micro-organisms such as bacteria, fungi, algae etc, over the surface of water.
6. **Radioactive waste:** The waste materials released from nuclear power plants normally contains hazardous radioactive substances, which are disposed off in water bodies, causing water pollution. Further, during explosion of nuclear bomb, a part of the radioactive particles settles down in the surface of earth which is washed off into water bodies during rainy season causing water pollution.

Effects of water pollution:

1. Water pollution leads to several diseases including cholera, diarrhoea, and many others. These water borne diseases are caused due to the consumption of polluted water.
2. It also leads to the depletion of resources found in water, both in terms of quality and quantity.

Controlling methods of water pollution:

The following steps may be taken to control water pollution:

i. Awareness must be created amongst the public regarding the adverse effect of water pollution. Various demonstrations regarding the control of water pollution.

ii. Bigger particulates should be trapped at the source of pollution, by using filtration units.

iii. Industrial effluents containing toxic substances like compounds of Zn, Cd, Hg etc must not be allowed to enter river water. Rather they should be treated separately and disposed in suitable place.

iv. The disposal sites of waste materials should be chosen carefully, so that they should not affect the ground water.

v. Sulabh public toilets should be constructed and excretion should not be made on the bank of rivers, lakes, etc.

vi. Chemicals such as chlorine tablets, bleaching powder should be used to purify water.

vii. Wastewater should be allowed to enter into crop fields or that should be used in fish management.

ACID RAIN:

Rainwater is considered to be the purest form of natural water. But when it drifts towards the surface of earth, it comes across a large number of industrial gases such as CO2, SO2, SO3, NO2 etc and dissolves them to form different inorganic acids. When the pH value of rainwater falls below '5', it is termed as 'acid rain'.

$CO_2 + H_2O \rightarrow H_2CO_3$ $SO_2 + H_2O \rightarrow H_2SO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$ $2NO_2 + H_2O + O \rightarrow 2HNO_3$

These droplets of acids either coalesce together or get deposited over aerosol particles to form large droplets which tend to drift down wards causing acid rain.

Consequences of acid Rain:

i. Most of the aquatic creatures cannot survive if the pH value of water falls below 4. If the pH value of water falls below 6, the zooplankton and algal get destroyed, which ultimately affect the food availability of aquatic creatures.

ii. When acid rain falls on green leaves, the chlorophylls get destroyed. This inhibits the growth of plants and reduces the productivity.

iii. The exteriors of historical monuments such as Taj Mahal [of Agra] are destroyed, due to acid rain, which is a very popular historical monument made of marble is being attacked by acid rain due to high concentration of oxides of sulphur and nitrogen in the air.

iv. It corrodes metals and metallic statues. As a result, heavy metals like iron, lead and copper are leached into drinking water which has toxic effects.

v. Chemical imbalance occurs.

vi. Acid rain increases the acidity of water in the lakes which is lethal for the fishes. For this reason, some of the lakes have become fishless. Thus, it has greatly affected the fish population.

SOIL POLLUTION

Soil pollution refers to an undesirable decrease in the quality of soil, either by man-induced sources or natural sources or by both.

Soil is vital not only for the growth of plants and growing food but also cultivating raw materials for agro-based industries. Health soil is a significant prerequisite for human survival.

Causes of Soil Erosion

- Deforestation at large scale
- Over-grazing
- Mining
- Decrease in soil microorganisms
- Excessive use of chemical fertilizers
- Excessive use of irrigation
- Lack of humus content
- Improper and unscientific rotation of crops

Soil pollution leads to many harmful consequences such as decrease in agricultural production; reduced nitrogen fixation; reduction in biodiversity; silting of tanks, lakes and reservoirs; diseases and deaths of consumers in the food chain due to use of chemical fertilizers and pesticides, etc.

Soil Pollution Control

- Adoption of soil-friendly agricultural practices.
- Use of compost manures in place of chemical fertilizers; Use of bio-fertilizers and natural pesticides help in minimizing the usage of chemical fertilizers and pesticides
- Scientific rotation of crop to increase soil fertility.
- Proper disposal of industrial and urban solid and liquid wastes.
- Planting of trees to check soil erosion in slopes and mountainous regions.
- Controlled grazing.
- Reduction in the heaps of garbage and refuse.
- The principles of three R's − Recycle, Reuse, and Reduce − help in minimizing generation of solid waste.
- Formulation and effective implementation of stringent pollution control legislation.
- Improved sewage and sanitation system in urban areas.

Marine Pollution

Marine pollution is defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as hazardous to human health, obstruction of marine activities and lowering the quality of sea water.

Sources of Marine Pollution:

a. Municipal waste and sewage from residences and hotels in coastal towns are directly discharged into sea.

b. Pesticides and fertilizers from agriculture which are washed off by rain enter water courses and finally to sea. India is estimated to use 55,000 tons of pesticides annually and about 25 percent of it is carried to-ocean.

c. Petroleum and oil washed off from roads normally enter sewage system and finally into seas.

d. Ship accidents and accidental spillage at sea can therefore be very damaging to the marine environment.
e. Off shore oil exploration also pollute the sea water to a large extent,
f. Dry docking: All ships periodic dry docking servicing; cleaning the hulls etc. during this period when cargo compartments are emptied, residual oil goes into sea.
g. Pollution due to organic wastes: When O2 concentration falls 1.5 mg/L, the rate of aerobic oxidants reduced and replaced by the anaerobic bacteria that can oxidize the organic molecules without the use of oxygen.
h. Pollution due to oil: Crude oil is transported by sea after a tanker has unloaded its cargo of oil; it has to take on sea water ballast for return journey. This ballast water is stored in cargo compartments that previously contained oil.
During unloading of cargo certain amount of oil remains clinging to the walls of container and this may amount to 800t in a 200,000t tankers. The ballast water thus contaminated with oil. When fresh crag of oil is to be loaded these compartments are clean with water which discharges the dirty ballast along with oil into sea.
i. Tanker accidents: In the natural process, a large no. of oil tanker accidents happens every year. Sometimes this can result in major disasters.
j. Volcanic eruptions in the sea.
k. Deep Sea mining is a relatively new mineral retrieval process that takes place on the ocean floor. Ocean mining sites are usually done at about 1,400 – 3,700 meters below the ocean's surface. The vents create sulphide deposits, which contain precious metals such as silver, gold, copper, manganese, cobalt, and zinc. These raise questions about environment damage to surrounding areas. Removal of parts of the sea floor will result in disturbances to the benthic layer, and habitat of benthic organisms. Beside from direct impact of mining the area, leakage, spills and corrosion would alter the mining area's chemical makeup.
Effects of Marine Pollution:
a. Apart from causing Eutrophication, a large amount of organic wastes can also result in the development of red tides. These are phytoplankton blooms because of which the whole area is discoloured.
b. Commercially important marine species are also killed due to clogging of gills and other structures.
c. When oil is spilled on the sea, it spreads over the surface of the water to form a thin film called as oil slick. This damages marine life to a large extent. Commercial damage to fish by tainting which gives unpleasant flavor to fish and sea food reduces market values of sea food and causes death of birds through its effect on feathers. Birds often clean their plumage by pruning and in the process consume oil which can lead to intestinal, renal and liver failure.
d. For salt marshy plants oil slick can affect the flowering, fruiting and germination.
e. Organic waste addition results in end products such as hydrogen sulphide, ammonia and methane which are toxic to many organisms. This process results in the formation of an anoxic zone which is low in its oxygen content; from which most life disappears except for anaerobic microorganisms and renders the water foul smelling.
f. The coral reefs are the productive ecosystems offer many benefits to people. These coral reefs are threatened by (a) the sediments from deforestation carried by the runoffs, (b) the agricultural and industrial chemicals reaching through river discharges. To mention an example. River Ganga is estimated to carry 1.5 billion tons of sediments due to deforestation and intensive farming in India, Bangladesh, and Nepal through which it flows to Bay of Bengal.
g. Drill cuttings dumped on the seabed result in the production of toxic sulphides in the bottom sediment thus eliminating the benthic fauna.
Control Measures of Marine Pollution:
a. Introduction of sewage treatment plants to reduce BOD of final product before discharging into sea.

b. cleaning oil from surface waters and contaminated beaches can be accelerated using chemical dispersants which can be sprayed on the oil.
c. Load on top system reduce oil pollution cleaned with high pressures jets of water.
d. Crude oil washing: The clingage is removed by jets of crude oil while the cargo is being unloaded.
e. Skimming off the oil surface with a section device.
f. Spreading a high-density powder over the oil spill, so that oil can I be sunk to the bottom.

Noise Pollution

What is Noise Pollution?

The word noise is derived from a Latin word 'Nausea' which means sickness in which one feels to vomit. Noise is the unpleasant and undesirable sound which leads to discomfort to human beings. The intensity of sound is measured in decibels (dB). The faintest sound which can be heard by the Human ear is 1 Db. Due to increasing noise around the civilizations; noise pollution has become a matter of concern. Some of its major causes are vehicles, aircraft, industrial machines, loudspeakers, crackers, etc. Some other appliances also contribute to noise pollution like television, transistor, radio, etc. when used at high volume.

Types of Noise Pollution

Following are the three types of pollution:

- Transport Noise
- Neighbourhood Noise
- Industrial Noise

Transport Noise

It mainly consists of traffic noise which has increased in recent years with the increase in the number of vehicles. The increase in noise pollution leads to deafening of older people, headache, hypertension, etc.

Neighbourhood Noise

The noise from gadgets, household utensils etc. Some of the main sources are musical instruments, transistors, loudspeakers etc.

Industrial Noise

It is the high-intensity sound which is caused by heavy industrial machines. According to many research, industrial noise pollution damages the hearing ability to around 20%.

Causes and Sources of Noise Pollution

Following are the causes and sources of noise pollution:

•Industrialisation: Industrialisation has led to an increase in noise pollution as the use of heavy machinery such as generators, mills, huge exhaust fans are used, resulting in the production of unwanted noise.
•Vehicles: Increased number of vehicles on the roads are the second reason for noise pollution.
•Events: Weddings, public gatherings involve loudspeakers to play music resulting in the production of unwanted noise in the neighbourhood.
•Construction sites: Mining, construction of buildings, etc add to the noise pollution.

Noise Pollution Examples

Following are the examples of noise pollution:

•Unnecessary usage of horns
•Using loudspeakers either for religious functions or for political purposes
•Unnecessary usage of fireworks
•Industrial noise
•Construction noise
•Noise from transportation such as railway and aircraft

Effects of Noise Pollution on Human Health

Noise pollution can be hazardous to human health in the following ways:

•Hypertension: It is a direct result of noise pollution which is caused due to elevated blood levels for a longer duration.

•Hearing loss: Constant exposure of human ears to loud noise that are beyond the range of sound that human ears can withstand damages the eardrums resulting in loss of hearing.

•Sleeping disorders: Lack of sleep might result in fatigue and low energy level throughout day affecting everyday activities. Noise pollution hampers the sleep cycles leading to irritation and uncomfortable state of mind.

•Cardiovascular issues: Heart-related problems such as blood pressure level, stress, and cardiovascular diseases might come up in a normal person and person suffering from any of these diseases might feel the sudden shoot up in the level.

Prevention of Noise Pollution

Some noise pollution preventive measures are provided in the points below.

•Honking in public places like teaching institutes, hospital, etc. should be banned.

•In commercial, hospital, and industrial buildings, adequate soundproof systems should be installed.

•Musical instruments sound should be controlled to desirable limits.

•Dense tree cover is useful in noise pollution prevention.

•Explosives should be not used in forest, mountainous, and mining areas.

Thermal Pollution: Effects, Causes and Control of Thermal Pollution

An increase in the optimum water temperature by industrial process (steel factories, electric power houses and atomic power plants) may be called as "Thermal Pollution." Many industries generate their own power and use water to cool their generator.

This hot water is released into the system from where it was drawn, causing a warming trend of surface water. If the system is poorly flushed, a permanent increase in the temperature may result. However, if the water is released into the well flushed system, permanent increase in temperature does not occur.

Effects:

Many organisms are killed instantly by the hot water resulting into a high mortality. It may bring other disturbance in the ecosystem. The egg of fish may hatch early or fail to hatch at all. It may change the diurnal and seasonal behaviour and metabolic responses of organisms. It may lead to unplanned mi-gration of aquatic animals.

Macro-phytic population may also be changed. As temperature is an important limiting factor, serious changes may be brought about even by a slight increase in temperature in a population. For minimising thermal pollution, hot water should be cooled before release from factories and removal of forest canopies and irrigation return flows should be prohibited.

Causes or Sources of Thermal Pollution:

The various causes of thermal pollution are as follows:

(1) Coal-fired Power Plants:

Some thermal power plants use coal as fuel. Coal-fired power plants constitute the major source of the thermal pollution.

(2) Industrial Effluents:

Industries generating electricity require large amount of Cooling water for heat removal. Other industries like textile, paper, and pulp and sugar industry also release heat in water, but to a lesser extent.

(3) Nuclear Power Plants:

Nuclear power plants emit a large amount of unutilized heat and traces of toxic radio nuclear into nearby water streams. Emissions from nuclear reactors and processing installations are also responsible for increasing the temperature of water bodies.

(4) Hydro Electric Power:

Generation of hydro-electric power also results in negative thermal loading of water bodies.

(5) Domestic Sewage:

Domestic sewage is often discharged into rivers, lakes, canals or streams without waste treatment. The municipal water sewage normally has a higher temperature than receiving water. With the increase in temperature of the receiving water the dissolved oxygen content (DO) decreases, and the demand of oxygen increases and anaerobic conditions occur.

Control of Thermal Pollution:

Control of thermal pollution is necessary as its detrimental effects on aquatic ecosystem may be detrimental in the future. Viable solutions to chronic thermal discharge into water bodies are as follows:

(1) Cooling Ponds:

Cooling ponds or reservoirs constitute the simplest method of controlling thermal discharges. Heated effluents on the surface of water in cooling ponds maximize dissipation of heat to the atmosphere and minimize the water area and volume. This is the simplest and cheapest method which cools the water to a considerable low temperature. However, the technique alone is less desirable and inefficient in terms of air-water contact.

(2) Cooling Towers:

Using water from water sources for cooling purposes, with subsequent return to the water body after passing through the condenser is termed as cooling process. In order to make the cooling process more effective, cooling towers are designed to control the temperature of water. In-fact, cooling towers are used to dissipate the recovered waste heat so as to eliminate the problems of thermal pollution.

(3) Artificial Lake:

Artificial lakes are man-made bodies of water which offer possible alternative to once through cooling. The heated effluents may be discharged into the lake at one end and the water for cooling purposes may be withdrawn from the other end. The heat is eventually dissipated through evaporation.

These lakes have to be rejuvenated continuously. A number of methods have been suggested and developed for converting the thermal effluents from power plants into useful heat resources for maximizing the benefits.

Nuclear Hazards

Introduction:

According to International Atomic Energy Agency (IAEA), a nuclear and radiation accidents/ hazards is an event that has led to significant consequences to people, the environment, or the facility.

Risk or danger to human health or the environment exposed by the radiation emanating from the atomic nuclei is called as nuclear hazard. Nuclear hazard is an actual or potential release of radioactive material at a commercial nuclear power plant or a transportation accident.

Radiation Pollution

The process by which an atom changes from an unstable state to a more state by emitting radiation is called radioactive decay or radioactivity. The most common source of radiation is nuclear power plants. Other sources include:

- ☞ Spent-fuel reprocessing plants.
- ☞ By products of mining operations.
- ☞ Experimental research laboratories.

Impacts of Nuclear Radiation

SHORT TERM RECOVERABLE EFFECTS

- ☞ Short term effect on skin, hair loss, lungs and on reproductive organs.

LONG TERM IRRECOVERABLE EFFECTS

- ☞ Radiation sickness: A person's risk of getting sick depends on how much radiation the body absorbs. Radiation sickness is often fatal and can produce such symptoms as bleeding and shedding of the lining on the gastrointestinal tract.
- ☞ Bone marrow death is caused by a dose of radiation between 2 and 10 Gray and is characterized by the part of the bone marrow that makes the blood being broken down. Therefore, production of red and white blood cells and platelets is stopped due to loss of the blood-making stem cells.
- ☞ Cataract induction
- ☞ Cancer induction
- ☞ Infectious diseases resulting from nuclear attack such as dysentery, tuberculosis, cholera, pneumonia etc.

GENETIC

- ☞ The effect is suffered by the offspring of the individual exposed. Mutations of these reproductive cells are passed to the offspring of the individual exposed.

How Does Nuclear Radiation Harm the human body?

- ❖ Radioactive iodine and caesium are being released into the environment from the malfunctioning nuclear reactors in Japan.
- ❖ As radioactive material decays, or breaks down, the energy released into the environment has two ways of harming a body that is exposed to it,
- ❖ It can directly kill cells, or it can cause mutations to DNA. If those mutations are not repaired, the cell may turn cancerous.
- ❖ Children are most at risk for thyroid cancer, since their thyroid glands are 10 times smaller than those of adults as the radioactive iodine would be more concentrated in them. The Chernobyl accident released a plume of radioactive materials into the atmosphere in a fraction of a second. In the following years, the incidence of thyroid cancer among those exposed as children increased in Ukraine and nearby countries.

Minimizing Nuclear Hazards

1. Seek out and act on new information about hazards.
2. Improve nuclear plant systems, resources, and training to enable effective ad hoc responses to severe accidents.
3. Strengthen capabilities for assessing risks from beyond-design-basis events.
4. Further incorporate modern risk concepts into nuclear safety regulations.
5. Examine offsite emergency response capabilities and make necessary improvements.
6. Improve the nuclear safety culture.
7. Monitoring radioactivity around disposal sites.

The mitigation measures are to be applied in any nuclear power plants or nuclear facility in all stages:

- ☞ the mining of uranium or other substance,
- ☞ in transportation of nuclear materials,
- ☞ processing of nuclear fuels, using them and
- ☞ storage of the raw materials as well as storage of nuclear wastes.

- ➢ During Mining: Serious health risks exist during mining stage. There is also a lot of (rejected/ unutilized) waste heat that goes into environment.

- Decommissioning a reactor: When the life of a nuclear reactor/power plant is over, the plant is decommissioned. The cost of that operation is high. Both the reactor and the uranium enrichment facility in the plant are to be decommissioned so that the radiation levels are very low. Cutting, dismantling reactors, dismantling, packing, and disposing off the parts of reactors is expensive, time taking. Not only that it is a health threat to the people doing those jobs. Thus, disaster mitigation is important in decommissioning as there are threats to the environment.
- Radioactive waste management: It seems about ten thousand metric tonnes of spent high level nuclear fuel waste is produced each year in the whole world. The radioactive wastes have long half-life times. These need careful and elaborate management strategy that includes storage, and disposal or treatment to convert them into non-toxic form. One of the ways is to bury them deep inside Earth.
- Limits to mitigation measures: Nuclear reactor designs should be upgraded with newer safety standards. Many types of expected failures can be taken care of in the design, implementation, and operation. However, there are some multiple failures which are unexpected (with very less probability).

Solid Waste Management

Solid waste management refers to the collecting, treating, and disposing of solid material that is discarded or is no longer useful. Solid waste management is an important aspect of urban area management. Improper disposal of municipal solid waste can create unsanitary conditions, which can lead to environmental pollution and the outbreak of vector-borne disease.

The task of solid waste management presents complex technical challenges. They also pose various economic, administrative, and social problems which need urgent attention.

The major sources of solid waste are households; agricultural fields; industries and mining, hotels, and catering; roads and railways; hospitals and educational institutions; cultural canters and places of recreation and tourism, etc. Plastic waste is also a solid waste.

Classification of Solid Wastes

a. Municipal Waste
b. Hospital Waste
c. Hazardous Waste

Solid Waste Management – causes, effects and control measures of urban and industrial wastes.

Wastes are materials that are not prime products (that is products produced for the market) for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose.

Costs (Effects) of waste generated by society:

1. **Environmental costs**

Waste attracts rodents and insects which harbour gastrointestinal parasites, yellow fever, worms, the plague and other conditions for humans. Exposure to hazardous wastes, particularly when they are burned, can cause various other diseases including cancers. Waste can contaminate surface water, groundwater, soil, and air which causes more problems for humans, other species, and ecosystems. Waste treatment and disposal produces significant greenhouse gas (GHG) emissions, notably methane, which are contributing significantly to global climate change.

2. **Social costs**

Waste management is a significant environmental justice issue. Many of the environmental burdens cited above are more often borne by marginalized groups, such as racial minorities, women, and residents of developing nations. NIMBY (not-in-my-back-yard) is a popular term used to describe the opposition of

residents to a proposal for a new development close to them. However, the need for expansion and site of waste treatment and disposal facilities is increasing worldwide. There is now a growing market in the transboundary movement of waste, and although most waste that flows between countries goes between developed nations, a significant amount of waste is moved from developed to developing nations.

3. Economic costs

The economic costs of managing waste are high and are often paid for by municipal governments. Money can often be saved with more efficiently designed collection routes, modifying vehicles, and with public education. Environmental policies such as "pay as you throw" can reduce the cost of management and reduce waste quantities. Waste recovery (that is, recycling, reuse) can curb economic costs because it avoids extracting raw materials and often cuts transportation costs. The location of waste treatment and disposal facilities often has an impact on property values due to noise, dust, pollution, unsightliness, and negative stigma. The informal waste sector consists mostly of waste pickers who scavenge for metals, glass, plastic, textiles, and other materials and then trade them for a profit. This sector can significantly alter or reduce waste in a particular system, but other negative economic effects come with the disease, poverty, exploitation, and abuse of its workers.

There are many waste types defined by modern systems of waste management, notably including:

- municipal solid waste (MSW)
- construction waste and demolition waste (C&D)
- institutional waste, commercial waste, and industrial waste (IC&I)
- medical waste (also known as clinical waste)
- hazardous waste, radioactive waste, and electronic waste
- biodegradable waste

Causes for Solid Waste Generation –

1. Population increase
2. Growing Urbanization
3. Industry
4. Mining
5. Transport

Waste Management

Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to materials produced by human activity and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

Methods of disposal

1. Integrated waste management

Integrated waste management using LCA (life cycle analysis) attempts to offer the most benign options for waste management. For mixed MSW (Municipal Solid Waste) a number of broad studies have indicated that waste administration, then source separation and collection followed by reuse and recycling of the non-organic fraction and energy and compost/fertilizer production of the organic waste fraction via anaerobic digestion to be the favoured path. Non-metallic waste resources are not destroyed as with incineration and can be reused/ recycled in a future resource depleted society.

2. Plasma gasification

Plasma is a highly ionized or electrically charged gas. An example in nature is lightning, capable of producing temperatures exceeding 12,600 °F (6,980 °C). A gasifier vessel utilizes proprietary plasma

torches operating at +10,000 °F (5,540 °C) (the surface temperature of the Sun) in order to create a gasification zone of up to 3,000 °F (1,650 °C) to convert solid or liquid wastes into a syngas. When municipal solid waste is subjected to this intense heat within the vessel, the waste's molecular bonds break down into elemental components. The process results in elemental destruction of waste and hazardous materials.

3. Landfill

Disposing of waste in a landfill involves burying the waste, and this remains a common practice in most countries. Landfills were often established in abandoned or unused quarries, mining voids or borrow pits. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly designed, or poorly managed landfills can create several adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common by product of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can create odour problems, kill surface vegetation, and is a greenhouse gas.

Design characteristics of a modern landfill include methods to contain leachate such as clay or plastic lining material. Deposited waste is normally compacted to increase its density and stability and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity.

4. Incineration

Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash.

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid, and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.

5. Recycling

The popular meaning of 'recycling' in most developed countries refers to the widespread collection and reuse of everyday waste materials such as empty beverage containers. These are collected and sorted into common types so that the raw materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles or sorted directly from mixed waste streams.

The most common consumer products recycled include aluminium beverage cans, steel food and aerosol cans, HDPE and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines, and corrugated fibreboard boxes.

PVC, LDPE, PP, and PS are also recyclable, although these are not commonly collected. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required.

6. Sustainability

The management of waste is a key component in a business' ability to maintaining ISO14001 accreditations. Companies are encouraged to improve their environmental efficiencies each year. One way to do this is by improving a company's waste management with a new recycling service. (such as recycling: glass, food waste, paper and cardboard, plastic bottles etc.)

7. Biological reprocessing

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity and heat (CHP/cogeneration) maximizing efficiencies. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter. There is a large variety of composting and digestion methods and technologies varying in complexity from simple home compost heaps to small town scale batch digesters, industrial-scale enclosed-vessel digestion of mixed domestic waste (see Mechanical biological treatment). Methods of biological decomposition are differentiated as being aerobic or anaerobic methods, though hybrids of the two methods also exist.

Anaerobic digestion of the organic fraction of MSW Municipal Solid Waste has been found to be in several LCA analysis studies to be more environmentally effective, than landfill, incineration or pyrolysis. The resulting biogas (methane) though must be used for cogeneration (electricity and heat preferably on or close to the site of production) and can be used with a little upgrading in gas combustion engines or turbines. With further upgrading to synthetic natural gas it can be injected into the natural gas network or further refined to hydrogen for use in stationary cogeneration fuel cells. Its use in fuel cells eliminates the pollution from products of combustion (SOx, NOx, particulates, dioxin, furans,...).

8. Energy recovery

The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Recycling through thermal treatment ranges from using waste as a fuel source for cooking or heating, to anaerobic digestion and the use of the gas fuel, to fuel for boilers to generate steam and electricity in a turbine. Pyrolysis and gasification are two related forms of thermal treatment where waste materials are heated to high temperatures with limited oxygen availability. The process usually occurs in a sealed vessel under high pressure. Pyrolysis of solid waste converts the material into solid, liquid and gas products. The liquid and gas can be burnt to produce energy or refined into other chemical products (chemical refinery). The solid residue (char) can be further refined into products such as activated carbon. Gasification and advanced Plasma arc gasification are used to convert organic materials directly into a synthetic gas (syngas) composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam. An alternative to pyrolysis is high temperature and pressure supercritical water decomposition (hydrothermal monophasic oxidation).

9. Avoidance and reduction methods

An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), removing any food/liquid remains from cans, packaging and designing products that use less material to achieve the same purpose (for example, light weighting of beverage cans).

10. Waste handling and transport

Waste collection methods vary widely among different countries and regions. Domestic waste collection services are often provided by local government authorities, or by private companies in the industry. Some areas, especially those in less developed countries, do not have a formal waste-collection system.

ROLE OF AN INDIVIDUAL IN PREVENTION OF POLLUTION

Introduction

Environment protection has been burning issue in last half century. In order to tackle the menace of pollution, urgent steps have to be taken at not only global or country level, but also at local level. In fact, the role of individuals in prevention of pollution is of critical importance, because it is the individuals that make a community or country. Effort by each individual at his or her level can have a significant effect on global level. It has been aptly said "charity begins at home".

Aware and inspired individuals are strongest tool to tackle pollution. This is because an aware individual not only lessens the burden on state but also he/she can tackle problem of pollution more effectively as he/she is more familiar with problems persisting at local level and he himself/herself deals with them in his/her day to day life. It is better and more viable to prevent pollution by educating individuals than controlling pollution. Individuals should encourage to modify their lifestyle and living habits if that are not healthy for environment.

Ways in Which an Individual can Help in Prevention of Pollution

- Individuals should minimize wastage of resources such as electricity. Every unit of electricity saved is equivalent unit of electricity produced as it not only saves the fuel that would be used to produce that electricity, but also help to prevent pollution that is accompanied by burning of that fuel. Therefore, person should always switch off appliances when not in use.
- Individuals should prefer walking or use cycles instead of using motor vehicles, especially when distances to be travelled are small.
- Individuals can make considerable contribution by using mass transport (buses, trains, etc) instead of using personal vehicles.
- When going to workplace, colleagues from nearby localities should pool vehicles instead of going in individual personal vehicles.
- Taking personal vehicles for periodic pollution checks at centres approved by authorities.
- Individuals should reuse items whenever possible.
- Products that are made of recycled material should be given preference.
- Use gunny bags made of jute instead of plastic bags.
- Take part in environment conservation drives such as tree planting drives.
- Use water resources efficiently.
- Use renewable resources by installing equipment such as solar heaters and using solar cookers.
- Dispose potentially harmful products such as cells, batteries, pesticide containers, etc properly.
- Use of refrigerators should be minimised wherever possible as they are main source of CFC, which is responsible for Ozone layer depletion.
- Follow and promote family planning, as more population means more resources utilized and more resources utilized imply more pollution.
- Avoid making noise producing activities such as listening to loud music.
- Use handkerchiefs instead of paper tissues.
- Organize drives to clean streets and clean drains with help of other people of locality.
- Spread awareness and inspire other people to prevent pollution. Individuals should be encouraged to acquire information and innovations from world over and implement them locally.

DISASTER MANAGEMENT:

Disaster management refers to effective management of counter measures that are taken in order to mitigate the effect natural calamities that lead to desperate situations after calamities such as earthquakes, floods, landslides, tsunamis, etc. Although these sudden calamities are natural geographical processes that

have been taking place from beginning and have played important role in shaping of earth, these geographical activities are wreck havoc and bring misfortune to people in region affected. Among the 36 states and Union territories in the country, 22 are prone to disasters. Among all the disasters that occur in the country, floods are the most frequently occurring natural disasters, due to the irregularities of the Indian monsoon. About 75 percent of the annual rainfall in India is concentrated in three to four months of the monsoon season. As a result, there is a very heavy discharge from the rivers during this period causing widespread floods. Approximately 40 million hectares of land in the country has been identified as being prone to floods. Major floods are mainly caused in the Ganga-Brahmaputra-Meghna basin which carries 60 percent of the total river flow of our country. These processes inflict huge losses to life and property and it can take years for life to take normal shape.

Every region of the world will confront disaster in some way or other. As these disasters are sudden and rarely predictable, best way to mitigate their effect is to be prepared to them. This requires preplanning and professional approach.

Disaster management pivots around preplanning, which includes:

- ☞ Organizing general disaster management teams to respond to any general disaster and in any terrain.
- ☞ Organizing special quick response teams that are highly specific to nature and region of disaster.
- ☞ Most important part is identifying threats that a particular region is most venerable to. This involves setting up of research stations that study the terrain, climate and underground seismic activities of the region.

Floods

In order to pacify the effects of flood disaster, following steps must be taken:

1. Floods in general are caused by heavy and concentrated rains. Therefore, best defence is to study and predict weather developments and issue early warnings through broadcast and print media.
2. People should be evacuated to safer places and relief camps should be provided.
3. People who could not be evacuated should move to relatively higher places.
4. Dams and embankments must be constructed by the government to check the flow in regions frequently affected by flood disasters.
5. Floods often result in breaching of canal embankments and river embankments. Strength of these embankments must be periodically evaluated by authorities so that they can withstand deluge.
6. Sand bangs must be used to repair temporary breaches in canals during floods.

Earthquake

In order to abate the effect of earthquakes, these precautionary measures must be taken:

- ☞ People should evacuate buildings and stay in open until the time, tremors have ceased.
- ☞ In case people are unable to get out of the buildings, they should try and stay in corners of the rooms.
- ☞ People using transport should stop vehicles and wait for tremors to subside.
- ☞ Buildings should be made by using construction material that is recommended by authorities.
- ☞ Design of the houses and buildings must be approved by authorities. Rectangular building design is most effective design that can withstand earthquake.
- ☞ People should help each other and provide first aid to the victims and not just wait for disaster management teams to arrive.
- ☞ Temporary relief camps and rehabilitation centres should be provided to people who have been affected.
- ☞ Compensation should be given to people who lost their house and livelihood.

- People should be made aware and trained through campaigns to tackle adversities as it is not possible for disaster management teams to reach everywhere.

Cyclones

In order to abate the effect of cyclones, following measures are advised:

- With help of technology, advent and paths cyclones can be predicted to some extent. First and foremost measure is to vacate the region that is predicted to be affected.
- People should be warned about cyclones through weather news, internet, newspapers, radio broadcast, etc.
- People should take to shelter in safe buildings during cyclones. Storm shelter should be constructed by authorities.
- Fisherman should be warned not to go to sea.
- Electricity supply should be cut off to the region that is affected.
- Temporary relief camps and rehabilitation centres should be provided to people who have been affected.
- Compensation should be given to people who lost their house and livelihood.

Landslides

In general the chief mitigatory measures to be adopted for landslide areas are:

- Drainage correction,
- Proper land use measures,
- Reforestation for the areas occupied by degraded vegetation.
- Creation of awareness among local population.

Agencies Working on Disaster Management

1. **National disaster management authority (NDMA):**

NMDA is headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005. NDMA as the apex body is mandated to lay down the policies, plans and guidelines for Disaster Management to ensure timely and effective response to disasters.

2. **International association of emergency managers (IAEM)**

IAEM is a non-profit educational organization dedicated to promoting the goals of saving lives and protecting property during emergencies and disasters. The mission of IAEM is to serve its members by providing information, networking and professional opportunities, and to advance the emergency management profession. It currently has seven Councils around the World: Asia, Canada, Europa, International, Oceania, Student and USA.

3. **Red cross/Red crescent**

National Red Cross/Red Crescent societies often have pivotal roles in responding to emergencies. Additionally, the International Federation of Red Cross and Red Crescent Societies (IFRC, or "The Federation") may deploy assessment teams, e.g. Field Assessment and Coordination Team – (FACT) to the affected country if requested by the national Red Cross or Red Crescent Society. After having assessed the needs Emergency Response Units (ERUs) may be deployed to the affected country or region. They are specialized in the response component of the emergency management framework.

4. **United nations**

Within the United Nations system responsibility for emergency response rests with the Resident Coordinator within the affected country. However, in practice international response will be coordinated,

if requested by the affected country's government, by the UN Office for the Coordination of Humanitarian Affairs (UN-OCHA), by deploying a UN Disaster Assessment and Coordination (UNDAC) team.

HUMAN POPULATION AND THE ENVIRONMENT

There are 5 main concepts that our students struggle with when learning about population growth and the relationship of population to geological resource use:

1. overpopulation is a leading environmental problem,
2. exponential population growth and development leads to faster depletion of resources,
3. population grows exponentially,
4. why population prediction is difficult,
5. population is not evenly distributed throughout the world.

Variation of Population Among Nations

The distribution of world population densities show that while the great majority of the land surface is sparsely or moderately populated, but some limited areas are densely populated. The densely populated areas include Western Europe, the Indian subcontinent, the plains and river valleys of China, and north-eastern USA. High concentrations of people are also found in some relatively smaller areas, for example—the Nile valley of Egypt, the Islands of Java in Indonesia and the Southern part of Japan.

In terms of continents and countries, the world's population is very ill-balanced. More than half of the world's people live in Asia (approximately 3.7 billion), which accounts for only one-fifth of the world's land area; while North, Central and South America together occupying more than a quarter of the land surface, have only one-fifth of the population (1.3 billion). The African continent also accounts for a quarter of the land surface but has just over one-eighth (840 million) of the world population. On the other hand, Europe whose area is only one twenty-fifth of the total has about one-ninth (729 million) of the world's people.

The distribution within the continents is also uneven. In Asia, China alone, with about 1.29 billion people, accounts for one-third Asian and one-fifth of the world population. The Indian subcontinent has a further 1.3 billion people—India, 1.05 billion; Pakistan, 143.5 million; Bangladesh, 133.6 million; Nepal , 23.9 million; Sri Lanka , 18.9 million; Bhutan, 0.9 million; and Maldives, 0.3 million. In Europe too, the population is an evenly distributed. Far less people live in Northern European countries than in other European countries. The most populous European countries are Russia (143.5 million), Germany (82.4 million), United Kingdom (60.2 million), France (59.5 million); Italy (58.1 million), Ukraine (48.2 million), Spain (41.3 million) and Poland (38.6 million). In Africa and Americas people are for the most part spread very thinly across the land, leaving large sections such as Northern Canada, Southwest USA, the Sahara desert and the Amazon forest practically uninhabited.

2. Factors discouraging settlement

They are usually climatic or relief factors. The main factors are—cold, altitude, heat, drought, poor soils, inaccessibility, etc.

2. Factors encouraging settlements

They are –good land, flat or undulating terrain, the existence of mineral resources, a good climate suitable for a wide range of crops or a less equable climate suitable to the cultivation of specialized crops which have a good market, etc. Other factors include extension of roads, railways and other modes of transportation.

3. Population Explosion

The rapid growth of population is perhaps the most obvious factor affecting the present and future national and regional development, but it is by no means the only population problem in the world today. The main problem is that of 'Population Explosion'.

Population explosion doesn't mean overpopulation or population density. In fact, overpopulation or population density is not the major problem. The problem arises when the economic developments fail to maintain pace with population growth. So the most important factors regarding population are how fast population is growing; and most important is where it is growing. For example, Japan has a high population density but it ranked first on the human development index formulated by U.N.D.P. On the other hand low population density areas of Africa or S. America are unable to support the existing population. Thus, the size, distribution and structure of the population within a country must be viewed in relation to its natural resources and the techniques of production used by its population. The extent to which they are used and the way in which they are utilized determine whether an area/country is under- or over-populated and hence witnessing population explosion or not. A country is said to have an "optimum population" so long as the number of people is in balance with the available resources of the country. If in a country the process of industrialization accompanied by urbanization is not fast and education is not widespread, then this is really a grave situation called as Population Explosion.

Effects of population explosion

The effect of population explosion is numerous with far reaching consequences. Some of them are enumerated as under:

Unemployment,
Low living standard of people,
Hindrance in the process of development of economy
Pressure on agriculture land,
Low per capital income,
Lack of basic amenities like water supply and sanitation, education, health, etc.,
High crime rate
Environmental damage,
Migration to urban area in search of job,
Energy crisis,
Overcrowding of cities leading to development of slums.

29.3.2 Population explosion in Indian context

The population explosion, though a worldwide phenomenon, poses a serious threat to India as it has to maintain 16.9% of world's population on only 2.4%of the world's area. The present growth rate of 1.7% is much higher than the world population growth rate of 1.3%, which is of great concern.

In order to overcome this problem of population explosion, a sound Population Policy is required with the following objectives:

Quick economic development and raising the per capital income.

Significant reduction in birth rate, which is more fundamental and important than the first, by providing legal and fiscal motivations like raising age of marriage, legalization abortion etc.

The planning of population must not aim merely at controlling the rate of multiplication but it should also include the improvement of the quality of the population as well by providing better facilities in education, health, etc.

(iv) The death rate should be brought down further, as high death rate results in waste of human energy and resources.

Integrating population planning with economic planning.

We are thus facing a population explosion of crisis dimensions which has largely diluted the fruits of the remarkable economic progress that we have made over the last few decades. It is clear that simply to wait for education and economic development to bring about a desirable drop in fertility is not a practical solution. The time factor is so pressing and the population growth so formidable that we have to get out of this vicious circle through a direct assault upon the population problem as a national commitment.

29.3.3 Methods of birth control

The effectiveness of a birth control method is generally expressed by how many women become pregnant using the method in the first year of use. Thus, if 100 women use a method that has a 0 percent first-year failure rate, then 0 of the women should become pregnant during the first year of use. This equals 0 pregnancies per 100 woman-years, an alternative unit.

The most effective methods in typical use are those that do not depend upon regular user action.

a) Surgical sterilization, Depo-Provera, implants, and intrauterine devices (IUDs) all have first-year failure rates of less than one percent for perfect use. In reality, however, perfect use may not be the case, but still, sterilization, implants, and IUDs also have typical failure rates under one percent. The typical failure rate of Depo-Provera is disagreed upon, with figures ranging from less than one percent up to three percent.

b) other methods may be highly effective if used consistently and correctly, but can have typical use first-year failure rates that are considerably higher due to incorrect or ineffective usage by the user. Hormonal contraceptive pills, patches or rings, fertility awareness methods, and the lactational amenorrhea method (LAM), if used strictly, have first-year (or for LAM, first-6-month) failure rates of less than 1%. In one survey, typical use first-year failure rates of hormonal contraceptive pills (and by extrapolation, patches or rings) were as high as five percent per year. Fertility awareness methods as a whole have typical use first-year failure rates as high as 25 percent per year; however, as stated above, perfect use of these methods reduces the first-year failure rate to less than 1%. Intrauterine devices (IUDs) were once associated with health risks, but most recent models of the IUD, including the ParaGard and Mirena, are both extremely safe and effective, and require very little maintenance.

c) Condoms and cervical barriers such as the diaphragm have similar typical use first-year failure rates (14 and 20 percent, respectively), but perfect usage of the condom is more effective (three percent first-year failure vs six percent) and condoms have the additional feature of helping to prevent the spread of sexually transmitted diseases such as the HIV virus. The withdrawal method, if used consistently and correctly, has a first-year failure rate of four percent. Due to the difficulty of consistently using withdrawal correctly, it has a typical use first-year failure rate of 19 percent and is not recommended by some medical professionals.

d) Combining two birth control methods, can increase their effectiveness to 95% or more for less effective methods. Using condoms with another birth control method is also one of the recommended methods of reducing risk of getting sexually transmitted infections, including HIV. This approach is one of the dual protection strategies.

Aim of 'Family Welfare Programme'

In the year 1952, India launched a nation-wide family planning programme making it the first country in the world to do so. Unfortunately, family planning in India is associated with numerous misconceptions—one of them is its strong association in the minds of people with sterilization, while others equate it with birth control. The recognition of its 'welfare concept' came only when the family planning programme was named as 'Family Welfare Programme' in the year 1977. The concept of welfare is very comprehensive and is basically related to quality of life. The Family Welfare Programme aims at achieving a higher end- that is, to improve the quality of life of the people.

Although the performance of the programme was low during 1977-78, but it was a good year in the sense that it moved into new healthier directions. The 42nd Amendment of the Constitution has made "Population Control and Family Planning" a concurrent subject. The acceptance of the programme is now purely on voluntary basis. The launching of the Rural Health Scheme in 1977 and the involvement of the local people (e.g., trained Dais and Opinion leaders) in the family welfare programmes at the gross-root level were aimed at accelerating the pace of progress of the programme. India was a signatory to the Alma Ata Declaration, 1978. The acceptance of the primary health care approach to the achievement of 'Health For All by 2000 AD' led to the formulation of a 'National Health Policy' in 1982. The policy laid down the long-term demographic goal of Net Reproduction Rate (NRR)=1 by the year 2000-which implies a 2-child family norm-through the attainment of a birth rate of 21 and a death rate of 9 per thousand population, and a couple protection rate of 60% by the year 2000. The successive Five-Year Plans were accordingly set to achieve these goals. The Government of India involved a more detailed and comprehensive National Population Policy in 1986, to promote it on a voluntary basis as a 'movement of the people, by the people, for the people'. It has given family planning the broadest possible dimensions which include not only health and family welfare but also child survival, women's status and employment, literacy and education, socio-economic development and anti-poverty programmes.
The current approach in favour today is one of involvement and integration. The idea is to value those who stand to benefit from the programme and integrate the various attempts to propagate the same. Family Welfare Programme with such an approach can reduce the population growth to more manageable levels. Presently, the Family Welfare Programme seeks to promote on a voluntary basis, responsible and Planned Parenthood with one child norm, male or female, through independent choice of family welfare methods best suited to acceptors.

Problems of family welfare programme

The two major problem of Family Welfare Programme are:

1. Generally women are the major targets of family planning programmes. According to National Family Health Survey, the most widely used method of family planning in India is female sterilization. This shows that family planning has largely remained a women-cantered programme. Due to reluctance of men to use permanent methods, women are forced to accept family planning methods. Gender specificity or gender subordination has to be eliminated in the approach in the family planning programmes as far as possible.

3. The imbalance in the sex ratio (female/1000 male) across the nation, which is 933, is another worrisome factor. In states like Haryana (SR=861), Punjab (SR=874), U.P. (S.R=898), Delhi (SR=821), Sikkim (SR=875) and others, the girl-child is being discriminated against even before birth. The instance of female infanticide in these and other states has brought down the sex ratio to an all-time low. Though there is a law banning the determination of the sex of the child in the womb,

unscrupulous medical practitioners and short-sighted parents connive to prevent the birth of female children. There is, thus, an urgent need to prevent the misuse of technology through education and awareness.

ENVIRONMENT AND HUMAN HEALTH

Introduction

It is an established fact that environment has a direct impact on the physical, mental and social well-being of those living in it. The environmental factors range from housing, water supply and sanitation, psychosocial stress and family structure through social and economic support systems, to the organization of health and social welfare services in the community.

In fact, the occurrence, prevention and control of disease lies in the environment. If the environment is favourable to the individual, he or she can make full use of his or her physical and mental capabilities. On the contrary, if the environment is polluted it can affect the human health and his susceptibility to illness. Thus, protection and promotion of 'environment health' is one of the major global issues today. It includes the issues of urban environmental health, water quality and health, air quality and health, industry and health, and energy and health.

Urban Environment Health

Environmental degradation is especially serious around crowded urban centers. In cities around the world, the living conditions of hundreds of millions of people (especially poor people in developing nations) threaten their health, impose misery, have potentially catastrophic social consequences and contribute to illness, accidents and crime. The crises in the urban environment are causing more immediate effects on human health than the current changes in the natural environment.

In the developing nations, the current rural exodus has led to a rapid increase in the pre-urban populations living in overcrowded conditions with inadequate provisions of infrastructure and services. Though average rate of disease and death for many cities are lower than those of surrounding rural areas because of the presence of a high proportion of the nation's middle- and upper-income classes who enjoy a relatively good standard of health; but, in contrast, the poor in urban areas usually suffer the same or even high rates of disease and death as their rural counterparts.

Good housing and suitable physical and social environments promote good mental and physical health. The most serious psychosocial health problems are depression, alcohol and drug abuse, suicide, child and spouse abuse, delinquency and target violence (e.g. rape, teacher assault, etc.). However, strong social networks and a sense of community organization can have a mitigating effect on the level of psychosocial health problems. Studies have shown a higher prevalence of mental illness in low-income, rundown areas. Deteriorating inner city areas or urban area with declining economies are characterized by social disorganization and disintegration. They are inhabited by high- risk populations such as migrants, the homeless and street children. It has now been recognized that the environment plays an important role in violent behavior and that the public health sector has a legitimate role within the justice, social and education sectors in reducing the problem or urban environmental health.

Effect of water quality on human health

Water quality can have a significant effect on public health as a result of waterborne diseases. Inadequate supplies of water increase the problem of maintaining water quality, especially when there are multiple sources of water pollution such as sewage, industrial effluents, urban and agricultural runoff. According to an estimate about 170 million urban inhabitants and 770 million rural inhabitants lack access to safe and adequate water supplies. Most urban centres in Africa and Asia have no sewerage system at all; even where there is sewage disposal system, the system rarely serves more than a small proportion of the population. This means that human excrement and household wastes end up untreated in water sources.

The problem of maintaining water quality is particularly acute in the more urbanized areas in developing countries due to two main reasons-failures to enforce pollution control and inadequacy of sanitation system and garbage collection and disposal system.

Waterborne diseases are the largest single category of communicable diseases contributing to infant mortality in developing countries (about 1500 million cases of diarrhoea and some 4 million deaths per year). It is estimated that safe and sufficient water supplies can reduce infant and child mortality by more than 50 per cent.

Effect of air pollution on human health

Air pollution is a growing menace to health throughout the world. The problem of air pollution was first brought to sharp focus when air pollution epidemics took place in Los Angeles (1948), Donora (1948) and London (1952). In the London epidemic of 1952, thousands of people became ill and some 4000 people died within 12 hours. According to an estimate more than 1000 million urban residents worldwide are exposed to outdoor air pollution levels higher than those recommended by WHO. In many cities, the concentrations of air pollutants are already high enough to cause morbidity in susceptible individuals and premature mortality in the aged, particularly in those with respiratory problems.

Fossil fuels are the largest source of air pollution. The major sources of urban air pollution are overwhelmingly coal-fired (or oil-fired) power stations, motor vehicles, domestic cooking and heating (particularly when coal or biomass fuel is used) and industries. The symptoms are usually referable to the respiratory system. Health may be affected if acidified water (due to Acid Rains) is used untreated in water supplies. Depletion of ozone layer, due to the release of specific air pollutants, increases the incidence of skin cancer and cataracts. The indirect health effects, however, are likely to be more significant, such as changes in rainfall that may decrease agricultural production and the spread of diseases such as malaria to currently unaffected areas.

Effect of industrialization on human health

Industrialization has made many positive contributions to health. By and large, as countries move towards industrialization and generate wealth and employment, improved health should follow for their people. However, there are two exceptions to the general correlation between industrialization and human health. One exception is in some developing countries where there has been remarkable success in reducing mortality and improving the health of the poor. The second exception is where industrialization has itself led to significant adverse health effects through failure to properly plan for, and prevent the release of chemical, physical or biological pollutants into the environment. A number of major accidents in developing countries due to release of chemicals or to explosions have caused adverse health effects.

Industrial effluents have polluted many rivers, lakes and coastal environments, especially in developing countries where pollution control is seldom enforced. Furthermore, hazardous wastes are sometimes exported from developed countries to developing countries because the cost of export is lower than the cost of disposal in the country of origin. Usually, there is little concern for the health of the local populations.

Some of the common occupation diseases are silicosis, pneumoconiosis, lead and mercury poisoning, and skin diseases. Continued and frequent exposure to noise, especially in industry, give rise to serious health problems.

Impact of energy on human health

Energy is a pre-requisite for socio-economic development and has direct and indirect benefits for health. The WHO Commission on Health and Environment's Panel of Energy has identified four major environmental health issues related to energy:

- ☞ Urban air pollution resulting from fossil fuel combustion and vehicular exhausts.
- ☞ Indoor air pollution resulting from domestic use of coal and biomass fuels for cooking and heating.

- ☞ Accident prevention and control; and
- ☞ Possible consequences of climate change.

People in developed countries use about ten times more commercial energy than those in developing countries and burn approximately 70% of all the fossil fuel used globally. The combustion of fossil fuels, accounting for about 90% of global commercial energy production, is the largest source of greenhouse gases and atmospheric pollution. Vehicle emissions also contribute to the formation of tropospheric ozone, photochemical smog and acid rain. Though it is possible to mitigate the environmental health effects of fossil fuel combustion, but the technologies are expensive.

Indoor air pollution from the combustion of coal or unprocessed biomass fuels represents the biggest energy-related cause respiratory disease with long-term cardiovascular effects, particularly among women and children especially in developing countries.

In case of nuclear power plants, there are risks to health for present and future generations from accidents and unsafe disposal of nuclear wastes.

Indirect health effects from climatic changes result from increased levels of greenhouse gases produced by the combustion of fossil fuels.

What is AIDS? What are the Sources and Mode of Transmission of HIV Infection?

AIDS, the Acquired Immune-Deficiency Syndrome is a fatal illness caused by a retrovirus known as the Human Immuno-Deficiency Virus (HIV) which breaks down the body's immune system, leaving the victim vulnerable to a host of life-threatening opportunistic infections, neurological disorders or unusual malignancies. Once a person is infected with HIV, it is probable that the person will be infected for life. Strictly speaking, AIDS refers only to the last stage of the HIV infection. There are two types of HIV- the most common HIV 1 and HIV 2 (commonly found in West Africa). The high-risk groups include male homosexuals and bisexuals, hetero-sexual partners (including prostitutes), clients of STD, intravenous drug abusers, transfusion recipients of blood and blood products, haemophiliacs, and medical and paramedical staff. Since the first clinical evidence of AIDS in USA in 1981, the disease has become a more devastating disease than any other disease humankind has ever faced. It has acquired epidemic like proportion as more than 60 million people all over the world have been infected with the HIV (Africa-13.2%, Americans-13.6%, Asia-60.7%, Europe-12.0% and Oceania-0.5%).

Estimates of HIV infection cases in India are about 3.5 million. HIV sentinel surveillance data shows Maharashtra as the most affected state followed by Tamil Nadu, Andhra Pradesh, Karnataka and Manipur.

Sources of HIV Infection

The greatest concentration of HIV has been found in blood, semen and CSF (cerebo-spinal-fluid). Further, lower concentrations have been detected in tears, saliva, breast milk, urine, and cervical and vaginal secretions. But, till date, only blood and semen have been conclusively shown to transmit the virus.

AIDS is first and foremost a sexually transmitted disease. Recent researchers have found that deep kissing where saliva is exchanged can also infect the partner.

AIDS is also transmitted by transfusion of contaminated blood. Intravenous drug users are at a high risk because they often share needles and syringes. Any skin piercing (including injections, ear-piercing, tattooing or acupuncture) can also transmit the virus via infected instruments.

An AIDS-infected mother can transmit virus to her child during pregnancy (through the placenta) or during birth or via breast-feeding.

HIV/AIDS is not spread by

- ☞ Drinking water or eating food from the same utensils (glasses, cups, plates, etc.) used by infected person.
- ☞ Shaking hands.
- ☞ Hugging or facial kissing.

- ☞ Working with people who are HIV infected.
- ☞ Swimming in pools used by infected people.
- ☞ Sharing toilets.
- ☞ Mosquitoes or any other insects.
- ☞ Casual social contact with infected persons even within households. That is, HIV is not spread by sitting next to someone who is infected, coughing or sneezing; but if person has any cuts or sores on his/her hands then make sure they are covered with plasters (band-aids or bandages).

Major precautions to avoid AIDS

The three major precautions to avoid AIDS are:

- ☞ Use condoms
- ☞ Use disposable syringes.
- ☞ Avoid multiple partners.

Control of AIDS

There are four basic approaches to control AIDS

1. Health education

Until a vaccine or cure for AIDS is found, the only means available at present is health education so as to enable people to make life-saving choices (for example, avoiding indiscriminate sex, using condoms). However, there is no guarantee that the use of condoms will give full protection. People should also avoid the use of shared razors and toothbrushes. Women suffering from AIDS or who are at high risk of infection should avoid becoming pregnant since infection can be transmitted to the unborn or new born. Intravenous drug users should avoid sharing of needles and syringes. Educational material and guidelines for prevention should be made widely available. All mass media channels should participate in educating the people on AIDS, its nature, transmission and prevention.

2. Prevention of blood borne HIV transmission

People in high-risk group should be asked to refrain themselves from donating blood, body organs, sperm and other tissues. All donated blood should be screened for AIDS before transfusion. Strict sterilization practices should be ensured in hospitals and clinics. Pre-sterilized disposable syringes and needles should be used as far as possible.

3. Treatment

There is no vaccine or cure for AIDS. However, there are certain medicines like 'Zidovudine (Azt), Lamivudine (3TC) and Saquinavir (SQR) which can delay the onset of AIDS after HIV infection. Strictly speaking-these medicines cannot cure; they can only control/delay the onset of AIDS.

4. Integration of AIDS control programmes

Due to its wide-ranging health implications, AIDS touches all aspects of primary health care, including mother and child health, family planning and education. Therefore, it is essential to integrate AIDS control programmes into country's primary health care system. AIDS control programmes will be of no use if they are developed in isolation.

Human Rights

The term 'Human Rights' refers to those basic rights which are essential for the development of human personality such as the right to life, liberty, property and security of an individual. The 'Universal Declaration of Human Rights' adopted by the United Nations on December10, 1948, states that-"the inherent dignity of all members of the human family is the foundation of freedom , justice and peace in the world". This is possible only when each and every human being enjoys fundamental rights, which include:

- ☞ The right to life, liberty and security of persons.
- ☞ The right to own property.

- ☞ The right to freedom of opinion and expression.
- ☞ The right to an adequate standard of living.
- ☞ The right to seek and to enjoy in other countries asylum from persecution.
- ☞ The right to education, freedom of thought, conscience and religion; and
- ☞ The right to freedom from torture and degrading treatment, etc.

Some of the important Articles of the Declaration are:
Article 1: deals with reason and conscience in the common spirit of brotherhood.
Article 2: deals with rights and freedoms irrespective of caste, sex, religion, etc.
Article3: deals with right to life, liberty and security of human beings.
Article4: deals with prohibition with slavery.
Article5: deals with prohibition of inhuman tortures and punishment.
Article6: deals with human recognition before law.
Article7: deals with equal protection against any discrimination in violation of human rights.
Article8: deals with the right to a remedy for acts violating the fundamental rights given by constitution.
Article9: deals with the protection against arbitrary arrest, detention and exile.
Article 12: says that none should be subjected to arbitrary interference with his privacy, family, home or correspondence, etc.
Article 13: deals with right to freedom of movement.
Article 12: says that men and women of full age without any limitation due to race, nationality or religion, have the right to marry.
Article 18: deals with the right to freedom of thought, conscience and religion.
Article 19: deals with the right to freedom of opinion and expression.
Article 20: deals with the right to freedom of peaceful assembly and association.
Article 23: deals with the right to work without any discrimination.
Article 26: deals with the right to education.

Problem of human rights

Alarmed by the horrors of the holocausts, the United Nations had adopted 'Universal Declaration on Human Rights' in 1948, motivated by the desire to recognize that the same rights belong to all people and every individual. And since then, the UN has been actively monitoring human rights violations in various parts of the world.

But many countries have protested against the UN declaration saying that it is discriminatory in nature as it is used to condemn underdeveloped countries. Many of the developing countries have even accused the West of practicing double standards. For instance, the US is quite willing to forget China's human rights violations (e.g., political dissidents are detained, and freedom of speech and expression are kept under considerable restraint in China) in return for a lucrative market. The US has even given China the status of 'Most Favoured Nation'.

The Malaysian former Prime minister, Dr. Mahathir Mohammad, has even launched a campaign for a review of the 'Universal Declaration on Human Rights'. He is of the opinion that the Declaration should take into account the Asian cultures in which the interests of the nation and society take precedence over those of the individuals.

Value Education

The field of value education is as broad as life itself. It touches every aspect of human life, personality and education. Value education, in its full range of meaning, includes developing the appropriate sensibilities-moral, cultural, spiritual and the ability to make proper value judgments and internalize them in one's life. Simply stated, value education is an education which teaches:

- ☞ How to live life well?
- ☞ How to find happiness?
- ☞ How to make others happy?
- ☞ How to behave and communicate with others?
- ☞ How to manage all kinds of people as well as happenings?
- ☞ How to grow and succeed in the right manner?

Value education, thus, is essentially 'Man Making' and 'Character Building'

The question then arises: "Which is more important-academic or value education?" The answer is simple, both are equally important. Without formal education, a person will not be able to read or write; and thus, without these skills to read or write, he/she cannot get a good job or manage even the simple things of daily living. Value education is equally important because if a highly qualified, well-employed person does not know how to behave properly, then all that he/she does has little meaning and will not serve him/her well. Therefore, fruitful education is the kind used for our welfare as well as that of others. And this can only happen when a person has both academic and value education.

Take the examples of two brilliant and very highly qualified scientists-one invents a life-saving drug, while the other invents a bomb. Though, both have a great deal of academic education but the scientist with character, a love for mankind and certain values, creates something that can save hundreds and thousands of lives; whereas, on the contrary, the other scientist creates something that can take hundreds and thousands of lives and cause pain and deformities even in future generations.

Emperor Asoka "The Great" had his early successes based on much violence. He became the King of Magadha only after killing nearly 90 of his kinsmen. One day, in the middle of the battle of Kalinga, he realised that there were no true victors in war because so many people died on both sides. He immediately renounced war and violence and became a follower of Buddha and thus changed his entire life. He, then, served his people in wonderful ways. Even today, he is honoured and remembered. On the contrary, many leaders who gave up good values just to gain power met with failure and death in the end. Adolf Hitler, at one time the most powerful man on Earth, misused his power to confiscate land and money of others, tortured and killed millions of people, and caused the Second World War. But when defeat neared, he didn't face it bravely-he killed himself. His power deserted him when he needed it most because he had gained that power by throwing away all the good values from his life. His power is just an external show, it was not inner strength.

Methods and strategies of imparting value education

The methods and strategies of imparting value education are many and varied. The selection depends much upon the value chosen, sources of development of these values and other limiting factors. The following approaches can be used for teaching values in character building activities:

1. Telling: It is a process for developing values to enable a pupil to have a clear picture of a value- laden situation by means of his own narration of the situation.
2. Inculcating: It is an approach geared towards instilling and internalizing norms into person's own value systems.
3. Persuading: it is the process of convincing the learner to accept certain values and behave in accordance with what is acceptable.
4. Modeling: Modeling is a strategy in which a certain individual perceived as epitomizing desirable/ ideal values is presented to the learners as a model.
5. Role playing: acting out the true feelings of the actor/ actors by taking the role of another person but without the risk of reprisals.

6. Simulating: It is a strategy in which the learners are asked to pretend to be in a certain situation called for by the lesson and then to portray the events and also by imitating the character's personality.
7. Problem solving: It is an approach wherein a dilemma is presented to the learners asking them what decision they are going to take.
8. Discussing situations, stories, pictures, etc: This technique asks the learners to deliberate on and explain the details in the lesson.
9. Studying biographies of great men: This is an approach that makes use of the lives of the great men as the subject-matter for trying to elicit their good deeds and thoughts worthy for emulation.
10. Moralizing: It is the process of working out a sense of morality through active structuring and restructuring of one's social experiences (e.g. moral reasoning and analysis).
11. Value clarification: It may be considered as learner-cantered. It relies mainly on the pupil's ability to process his beliefs and behave according to his beliefs, and also, to make a decision whenever confronted with the value dilemma.

ROLE OF INFORMATION TECHNOLOGY (IT) IN ENVIRONMENT

Introduction

Some of the areas in which information technology is playing a vital role in environmental management are briefly discussed as under:

Biodiversity conservation

Use of GIS (Geographic Information System) and Remote Sensing can help in determining the rates, causes and scale of biodiversity loss. Information on deforestation and land use change can be integrated with data on the distribution of biodiversity and existing information on climate, topography, soil, etc. to obtain a comprehensive picture.

Species monitoring

Not only the existence of flora and fauna can be detected, even counting of animals like elephants, tigers, etc. can be done with the help of GIS. The IUCN (International Union for Conservation of Nature) Red Database acts as an aid in appreciating the degree of danger that a species is in.

Site selection

GIS can help in the selection of optimum highway or railway routes, dam or reservoir sites, waste disposal sites, major industrial sites, etc. that can cause minimal disturbance to ecosystems.

Disaster management

Remote sensing data can be effectively used for obtaining near real time information on areas affected by earthquakes, cyclones, floods, landslides, volcanic eruptions, forest fires and other such disasters. Disaster prone areas can be identified where appropriate action can be taken up to reduce the losses and also disasters like cyclones, floods, etc. can be predicted well in advance.

Soil resources

Satellite data depict the nature of problem, degree of salinity, solidity and spatial extent of the problem in each mapping unit. The information is extensively used to plan for the reclamation of salt affected soils and for adopting post-reclamation production technology.

Water resources

Remote sensing data proved effective in inventorying, monitoring and managing both surface and ground water resources to augment the water use efficiency. Satellite data serves as a unique tool for extracting information on geology, geomorphology, drainage, land use and soils, which are essential in identifying not only the potential segments of agricultural resources, but also the sites suitable for site selection of recharge structures.

Role of Information Technology in Human Health

Its various applications include:

- **Bioinformatics and osteoporosis**

The application of bioinformatics is in the emerging possibility for the cure of osteoporosis-a crippling disease caused by the breakdown of bone, caused by a class of molecules called Cathepsin K. Now the pharmaceutical companies have to find a drug that blocks the Cathepsin K gene only.

- **Role in genome sequencing**

Bioinformatics played a key role in the final stages of the Human Genome Project. In just four weeks, James kent (a Ph.D student of California University) produced a computer programmers that helped the public consortium to complete the sequencing in time and to present the draft sequence along with Celera Genomics on June26, 2000.

- DNA databases or data banks having genetic information about populations together with their personal physical characteristics (eye colour, height, weight, etc.), fingerprints, dental records, medical records, financial records, etc. are used by the Government Departments to identify missing persons, by the investigating agencies (e.g., FBI, CBI, RAW, etc.) to identify criminals, and also by the insurance companies to prevent insurance fraud.
- Many organizations, such as WHO, maintain their web sites with information about endemic, epidemic and communicable diseases to inform people about dangers involving populations.
- Information about new drug release, their mode of action, indications and risk are also available on web sites.
- Any new development in the field of surgery is also available on net to be referred by the doctors of any country at any time.
- Telemedicine and distance medicine is now far-reaching along with documentation and display of human anatomy with the help of internet.