

LECTURE NOTES

ON

ENVIRONMENTAL STUDIES (TH5)

For

3RD SEM MECHANICAL ENGG

(SCTE&VT SYLLABUS)



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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. Ecology is the study of the interactions between an organism of some kind and its environment. As given by Environment Protection Act, 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.

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 man 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 generations 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 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 of protected areas 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.

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.

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.

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.

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 subsistence 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 Vindhya and the Western Ghats.

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.

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.

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 water exceeds 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.

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:

Case Studies:

1. **India vs Bangladesh:** India plans to link major rivers flowing from the Himalayas and direct them to the drought prone south India. But the Bangladesh government estimate that even 10% to 20% reduction of water flow to their country would dry out large areas for most of the year. It will adversely affect Bangladeshi farmers. They plan to raise the issue in the United Nations forum and request to frame laws.
2. **Karnataka vs Tamilnadu:** There was widespread violence when Karnataka rejected an interim order handed down by the Cauvery Waters Tribunal, set up by the Indian Supreme Court to settle decades of water dispute between the two states over irrigation rights to the Cauvery River water.
3. **Odisha vs Chhattisgarh:** There has been protests in Odisha over the sharing of water from the river Mahanadi because flow of water in the upstream river is controlled by Chhattisgarh.

4. India vs Pakistan: There has been dispute between India and Pakistan over the sharing of water in Ravi-Sutlej dam.

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

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.

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 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.

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:

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 be 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 engines 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.
- 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 rock 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

Below the earth's crust temperature increases with depth. Temperature at the core of the earth may go up to 4,800⁰ C where all the heavy metals are in a molten lava state. This heat energy can successfully be trapped and can be converted into electrical energy popularly known as Geothermal energy. 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.

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.

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.

Energy cropping:

Raising crops like sugarcane, sugar beet, potato maize. Etc. purely for production of ethanol is called energy cropping and the crops are called energy crops. The wastes from sugar industry such as bagasse, molasses and press mud can be processed for production of ethanol.

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

Sun rays are trapped in photovoltaic cells which are then converted into electrical energy and stored in batteries. Solar energy contributes less than 0.5% of global energy production. 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.

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.

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.

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.

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.

Important Questions

No 1. Define environment.

No.2 Write importance of environment study.

No.3 Write scope of the environment studies.

No.4 What is need of public awareness?

LECTURE NOTES ON

ENVIRONMENTAL STUDIES (TH5)

For

3RD SEM MECHANICAL ENGG

(SCTE&VT SYLLABUS)



Prepared by
ER SUBARNA KESHARI SINGH
LECT Mechanical Engg

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).

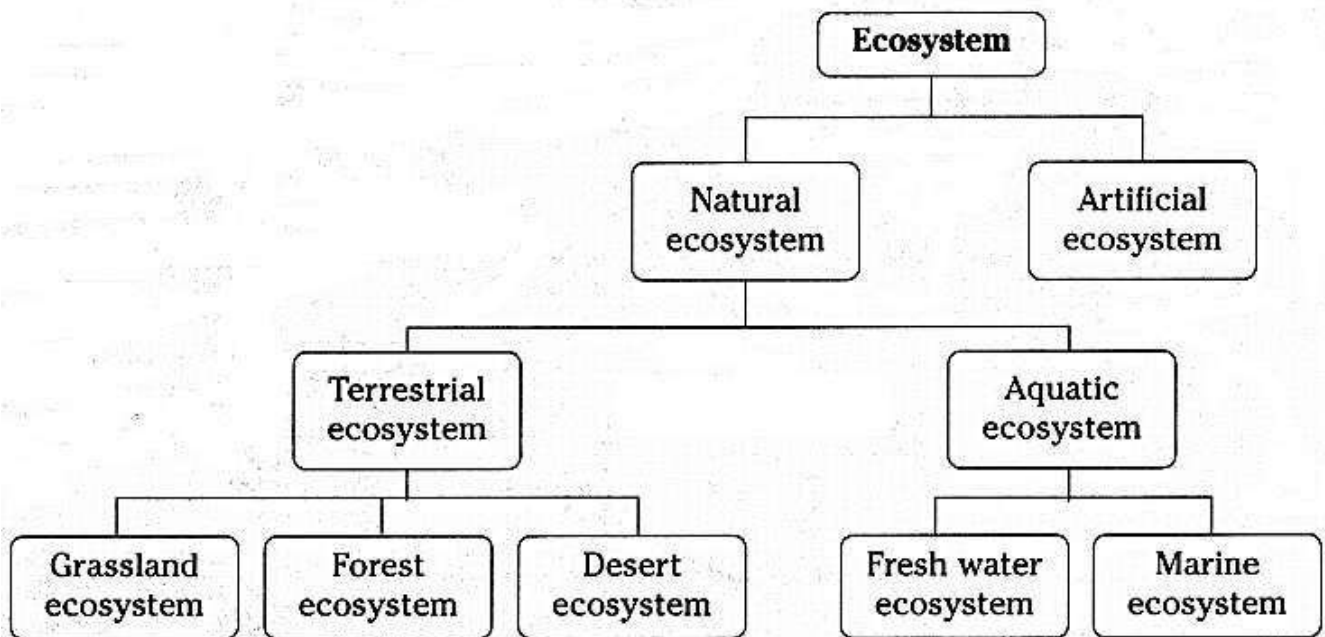
The study of ecosystem or environmental studies has been seen to be multidisciplinary in nature, hence, it is considered to be a subject with great scope. It is no more confined only to the issues of sanitation and health; rather, it is now concerned with pollution control, biodiversity conservation,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

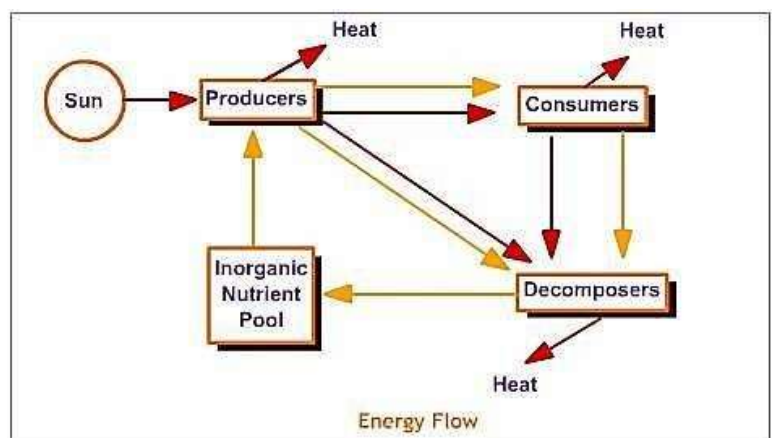
Understanding the food chain helps us know the feeding interrelationship and interaction between an organism and the ecosystem. It also enables us to know the mechanism of energy flow in an ecosystem.

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.

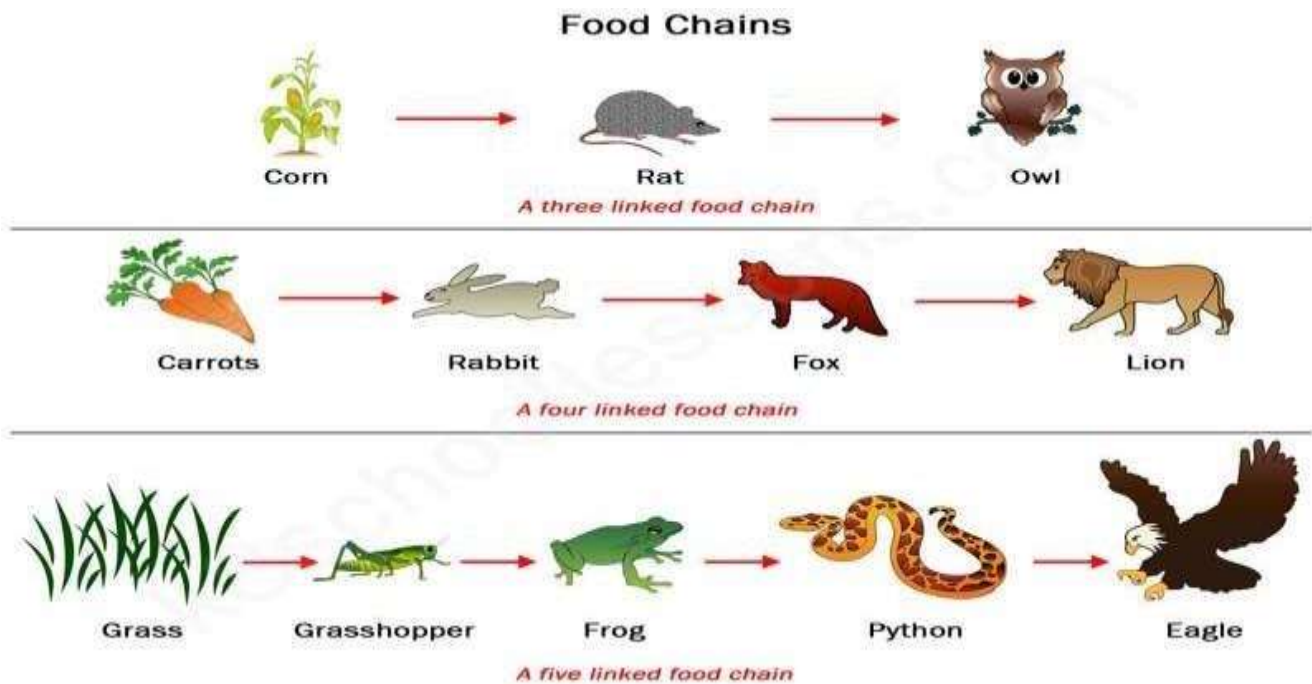
Food Chain

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)

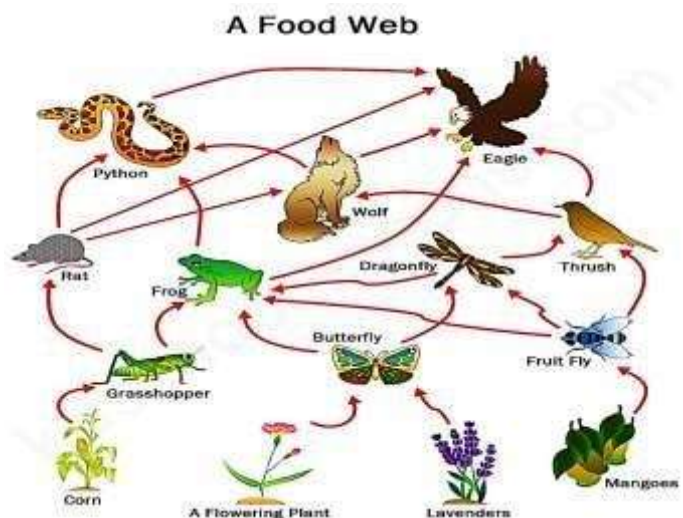


Food Web:

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

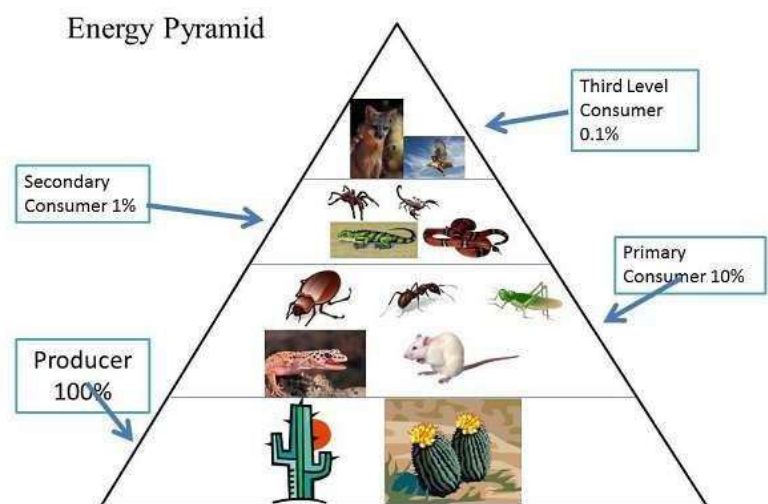
As the name suggests, the Biomass Pyramids show the amount of biomass (living or organic matter present in an organism) present per unit area at each trophic level. It is drawn with the producers at the base and the top carnivores at the tip.

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.



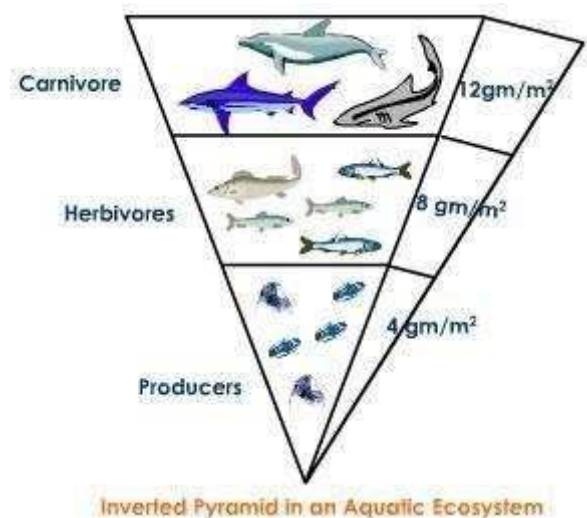
Inverted Pyramid of Biomass

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.

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.

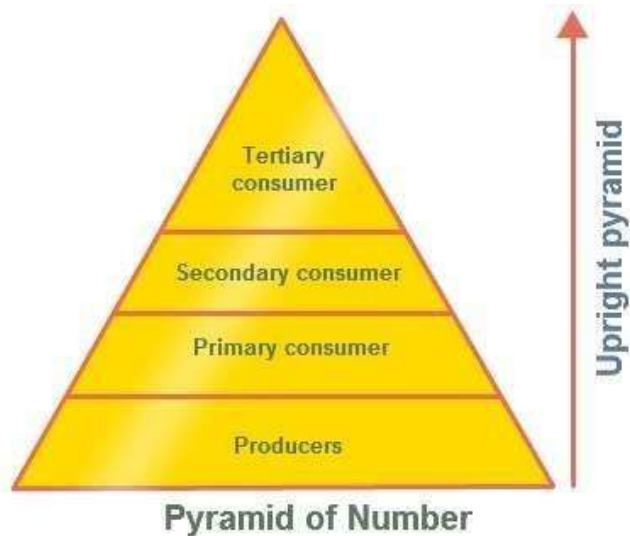


For example, in an aquatic ecosystem or grassland areas, autotrophs or producers are present in large number per unit area. The producers support a lesser number of herbivores, which in turn supports fewer carnivores.

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.



Inverted Pyramid of Numbers

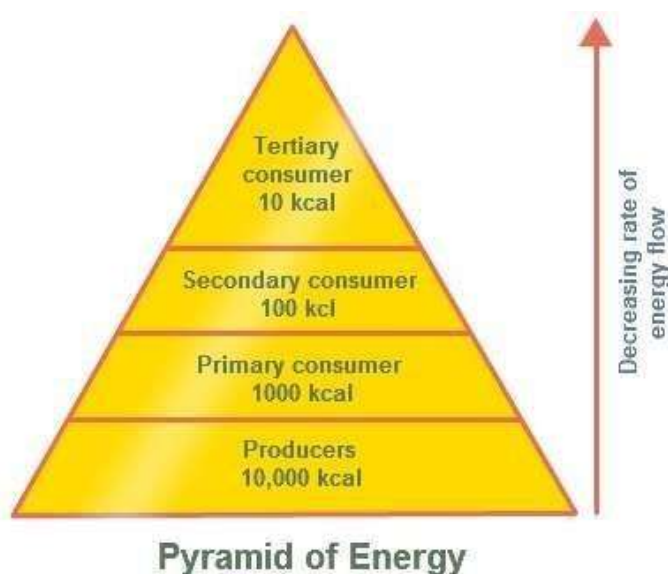
Here, the number of individuals increase from the lower level to the higher trophic level. For example, the tree ecosystem.

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.



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 streams, 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).

3. 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.

4. 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.

5. 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 less 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 rich in nutrients in abundance. Estuaries are useful to human beings due to their high food potential. Hence, estuaries must be protected from pollution.

POSSIBLE QUESTION & ANSWER

1 Define Ecosystem

- 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.
-

2. Define Biotic & Abiotic component

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.

3. Define Producer & consumer

- **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.
- **Consumers** – At the second trophic level, there are consumers who depend upon others for food.

4. What is 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

5. What is 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.

6. Write short note about Food web

- The word 'web' means network. Foodweb 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 asingle ecosystem.
- It is essential to know that each living thing in an ecosystem is a part of multiple food chains

7. Write Short note about forest Ecosystem

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:

- **Species composition:** It refers to the identification and enumeration of the plant and animal species of a forest ecosystem.
- **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:

- 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.

8. Write short note about River Ecosystem:

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PNS SCHOOL OF ENGINEERING & TECHNOLOGY

**LECTURES NOTE ON
ENVIRONMENTAL STUDIES (TH-5)**

**PREPARED BY
SUBARNA KESHARI SINGH
LECT IN MECHANICAL ENGG**

UNIT -6 SOCIAL ISSUES AND THE ENVIRONMENT

From Unsustainable To Sustainable Development – Urban Problems Related To energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, Its Problems and Concerns, Case Studies – Environmental Ethics:- Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies – Wasteland Reclamation – Consumerism and Waste Products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues Involved in enforcement of Environmental Legislation – Public Awareness.

SOCIAL ISSUES AND ENVIRONMENT

Introduction:

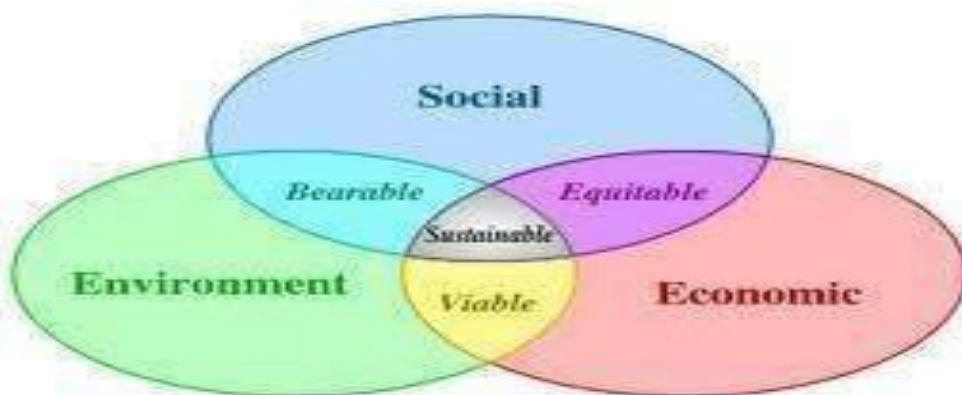
From Unsustainable to Sustainable Development

Man is part of the nature and he is bound to obey the laws of nature. He depends on his environment for basic things. More developmental activities are adopted in order to increase the quality of life. For that he uses the available resources. The Earth has limited supply of resources and renewable resources. These are to be managed in a scientific manner for availing the generations to come. Hence developmental activities are to be taken with more care about the environment and its protection. It brings benefits to all not only to the present generation but also for future generations.

Sustainable development: Meeting the needs of the present without compromising the ability of future generation to meet their own needs.

Important components of Sustainable development:

1. Economic development
2. Community development
3. Environmental protection



True sustainable development aims at optimum use of natural resources with high degree of reusability, minimum wastage, least generation of toxic by-products and maximum productivity. Aspects of sustainable development:

Inter generational equity-It states that we should hand over a safe, healthy and resourceful environment to future generation.

Intra generational equity:

A technological development of rich countries should support the economic growth of poor countries and help in narrowing the wealth gap and lead to sustainability.

Approaches for sustainable development:

1. Developing appropriate technology-technology which is locally adoptable, ecofriendly, resource efficient and culturally suitable should be adopted. It uses local labour, less resources and produces minimum waste.
2. Reduce ,Reuse and Recycle (3Rapproach) –Optimum use of natural resources using it again and again instead of throwing it on wasteland or water and recycling the material in to further products. It reduces waste generation and pollution.
3. Providing environmental education and awareness-Thinking and attitude of people towards earth and environment should be changed by providing environmental awareness and education.
4. Consumption of renewable resources- It is very important to consume the natural resources in such a way that the consumption should not exceed the regeneration capacity.
5. Non-renewable resources should be conserved by recycling and reusing.
6. By population control we can make sustainable development.

Urban problems related to energy:

Urbanization –Movement of human population from rural; areas to urban areas for want of better education, communication, health, employment etc.

Causes:

Cities are the main centers of economic growth, trade transportation, medical facilities and employment.

Urban sprawl:

The phenomenon of spreading of the cities in to sub-urban or rural areas is called urban sprawl. Urban growth is so fast and is difficult to accommodate all commercial industrial residential and educational facilities within the limited area.

Energy demanding activities:

Urban people consume lot of energy and materials in comparison with rural people. This is because urban people have high standard of life and their life style demand more energy.

Examples for energy demands:

1. Residential and commercial lightings.
2. Industries using large proportion of energy.
3. Usage of fans fridge, A.C, washing machines.

Control and prevention of pollution technologies need more energy.

Solution for urban energy problems:

1. Energy consumption must be minimized in all aspects.
2. Public transportation should be used instead of motor cycles and cars.
3. Using of solar energy and wind energy.
4. Production capacity must be increased.

WATER CONSERVATION

The original source of water is precipitation from the atmosphere. The water available on the earth may occur in all three stages as gas, liquid or solid. Temperature is the main factor in deciding the state of water. As a liquid, the water forms hydrosphere. About 75% of the Earth's surface is covered by the hydrosphere.

The process of saving water for future utilization is called conservation of water.

Need for water conservation.

1. Better life style requires more fresh water.
2. Agriculture and Industrial activities require more fresh water.
3. As the population increases the requirement of water is also more .

Strategies of water conservation

Reducing evaporation losses

Evaporation of water in humid regions can be reduced by placing horizontal Barriers of asphalt below the soil surface.

Reducing irrigation losses

Sprinkling and irrigation conserves water by 30- 40%. Irrigation in early morning (or) later evening reduces evaporation losses. Growing hybrid crop varieties also conserve water.

Reuse of water

Treated waste water can be reused for irrigation. Water from washings, bath rooms etc. can be used for washing cars, gardening.

Preventing of wastage of water

Closing the taps when not in use and repairing any leakage from pipes.

Decreasing run off losses

Run off , on most of the soils can be reduced by using contour cultivation (or) Terrace farming.

Avoid discharge of sewage

Disposal into natural water resources should be avoided

Methods of water conservation

Rain water Harvesting and Watershed management

What is Water Harvesting

It means capturing rain where it falls or capturing the run off in your own village or town. And taking measures to keep that water clean by not allowing polluting activities to take place in the catchment.

Therefore, water harvesting can be undertaken through a variety of ways

Capturing runoff from rooftops

- Capturing runoff from local catchments

- Capturing seasonal floodwaters from local streams

- Conserving water through watershed management

These techniques can serve the following the following purposes:

- Provide drinking water

- Provide irrigation water

- Increase groundwater recharge

- Reduce stormwater discharges, urban floods and overloading of sewage treatment plants

In general, water harvesting is the activity of direct collection of rainwater. The rainwater collected can be stored for direct use or can be recharged into the groundwater. Rain is the first form of water that we know in the hydrological cycle, hence is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water. In present times, we depend entirely on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feeds all these secondary sources and remain ignorant of its value. Water harvesting means to understand the value of rain, and to make optimum use of the rainwater at the place where it falls.

Rainwater harvesting. It is a technique of collecting and storing rain water for use in non-monsoon periods. In the present age, concrete houses, well-built roads, footpaths and well –concreted courtyards have left few open grounds. With the decrease in natural forest cover, increase in concrete jungles and the decrease in exposed earth; very little open ground is left for water to soak in and thereby increase the ground water table. So, artificial recharging of the ground water is extremely essential. It is done through rain water harvesting. For the purpose, rain water is collected at the roof top or in an open well and then carried down for immediate use or it is directed into the aquifer.

Rain water harvesting techniques

There are two main techniques for rain water harvesting:

1. Storage of rain water on the surface for future use
2. Recharge of ground water

Recharge of ground water is a recent concept and the structures used for the purpose are:

- Pits
- Trenches

- Dug wells
- Hand pumps
- Recharge shaft
- Lateral shafts with bore wells
- Spreading technique

Objectives of rain water harvesting.

1. To raise the water table by recharging the ground water.
2. To minimize water crises and water conflicts
3. To reduce rain water run off and soil erosion.
4. To reduce the ground water contamination from intrusion of saline water

Concept of rain water harvesting

Rain water harvesting involves collecting water that falls on roof of house during Rain and conveying water through PVC or Al pipe to a near by covered storage tank.

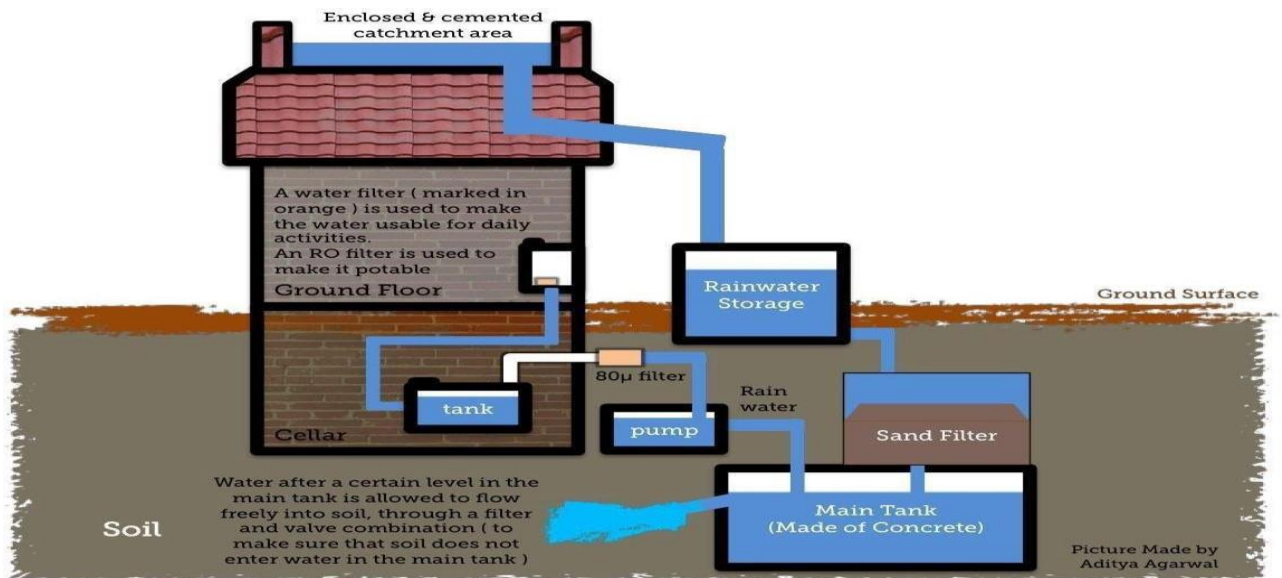
Method of rain water harvesting

1. Roof top method: collecting rain water from roof of the building and storing in the ground. It is the low cost and effective technique for urban houses and buildings.
2. The rain water from roofs, road surfaces, play grounds is diverted into the surface tank or recharge pits. The pit base is filled with stones and sand which serves as a

Advantages:

Rise in ground water level and minimizing the soil erosion and flood Hazards. Scarcity of water is reduced.

Rainwater harvesting systems channel rainwater that falls on to a roof into storage via a system of gutters and pipes. The first flush of rainwater after a dry season should be allowed to run to waste as it will be contaminated with dust, bird droppings etc. Roof gutters should have sufficient incline to avoid standing water. They must be strong enough, and large enough to carry peak flows. Storage tanks should be covered to prevent mosquito breeding and to reduce evaporation losses, contamination and algal growth. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic.



WATERSHED MANAGEMENT

Water shed (or) drainage basin: It is defined as land area from which water drains under the influence of gravity into stream, lake, reservoir (or) other body of surface water. Watershed management of rain fall and resultant run off is called watershed management.

Factors affecting watershed :

1. Overgrazing . deforestation , mining , construction activities affect and degrade watershed.
2. Droughty climate also affects the water shed.

Need or objectives of watershed management

1. To raise the ground water level.
2. To protect the soil from erosion by run off.
3. To minimize the risks of floods, drought and landslides.
4. To generate huge employment opportunities in backward rain fed areas to ensure security for livelihood.

Watershed management techniques

Trenches (pits) were dug at equal intervals to improve ground water storage. Earthen dam or stone embankment must be constructed to check run off water.

Farm pond can be built to improve water storage capacity of the catchment's area.

Maintenance of watershed

Water harvesting: Proper storage of water in water shed can be used in dry season In low rainfall areas.

Afforestation and agro-forestry help to prevent soil erosion and retention of moisture in watershed areas

Reducing soil erosion: Terracing, contour cropping minimize soil erosion and run off on the slopes of water sheds

Scientific mining and quarrying minimize the destructive effect of mining in water shed areas **Public participation** is essential for water shed management. People should be motivated for maintaining water harvesting structures implemented by the government.

RESETTLEMENT & REHABILITATION

Based on the resettlement schemes proposed by each affected village and present policies, laws and regulations of different levels of governments and the resettlement requirements of ADB, the Resettlement Plan of Lauding Expressway Project was prepared by PPTA consulting team and the staff from NPAEC under GPCD assisted by design institute and Local County and township governments.



Target and Task

The overall objective of resettlement and rehabilitation is to ensure that the affected production base will be restored, the affected labor force will be re-employed, and income and livelihood of affected people will be improved or at least restored to their previous levels before resettlement.

At present, the rural population of project impact area is mainly engaged in agricultural activities, with most of their income coming from planting, economic trees, and animal husbandry. According to the actual production and living standard among affected villages, and the approved economic and social development plans for the relevant counties, the target of

Resettlement and rehabilitation is set as follows:

- (1) The resettlement's grain production level will be self-sufficient after resettlement.
- (2) The income per capita shall be recovered to the standard before resettlement.
- (3) The affected public infrastructures, school, hospitals, social welfare level, natural environment and traffic condition etc. shall be improved after resettlement.

Resettlement Task

In 2005, there were 2,829 households with 13,149 persons to be resettled or rehabilitated, in which 520 households and 2,352 persons will need house relocation.

The basic resettlement policy of Lauding Expressway Project is to respect the wishes of affected People and maintain their current production and living traditions. Based on consultation of local affected peoples, the economic rehabilitation will be based on developing replaced farming Resources within their own townships and villages. Planting will be the focus of economic Rehabilitation strategy by developing new farmland and improving the remaining farmland in the affected villages, and supplemented by developing various other income generation opportunities in the project areas. In other words, the resettlement and rehabilitation strategy will first to reestablish the physical production bases for the affected persons, which will provide a long-term development potential by fully utilizing local land resources.

Resettlement Principle

Under such policy, a number of resettlement and rehabilitation principles have been developed for the Project.

(1) The resettlement plan will be based on detailed inventory for land acquisition and houses Demolition, and adopted compensation standards and subsidies.

(2) The resettlement shall be combined with the local development, resource utilization and Economic growth as well as environment protection. Considering the local conditions, a Practical and feasible resettlement plan should be developed to restore or improve their Economic production and create basic conditions for long-term development.

Overall Scheme of Resettlement

Since the construction of Lauding Expressway Project will only acquire limited land acquisition and demolition along the road alignment line, it will not have significant negative impacts on production and livelihood for most affected villages. A series of consultation meetings were held among affected villages and townships. According to the resettlers' opinion and suggestion, and combined with the actual condition of affected area, the basic rehabilitation scheme was determined as follows:

(1) Project affected persons will be resettled within their original villages and village groups, so

that their way of production, living and social relationship can be maintained, which will be beneficial for them to restore or improve their production and income level after resettlement.

(2) In order to reduce the impacts on the production and livelihood among resettlers, the demolished houses will be dismantled after the new houses built. The reconstruction of houses will adopt two approaches. For most relocated households, they will choose to rebuild their houses by themselves, and all salvage materials will belong to them. The second approach is for those who live near towns, their rehabilitation will be carried out by local government in order to promote small town development and save farmland.

(3) The rural relocated households will be resettled in their original villages. For those who lose

Some farmland, the land-based rehabilitation will be adopted with a combination of developing new farmland, redistributing remaining farmland and receiving their share of resettlement subsidy among affected village groups.

Environmental Ethics

It refers to issues, principles and guidelines related to human interactions with their Environment. **(OR)**

Ethics is a branch of philosophy. It deals with morals and values. An ethic is a principle or value that we use to decide whether an action is good or bad.

Ethics differs from country to country.

Functions of Environment:

1. It moderates climate conditions of the soil.

2 A healthy economy depends on healthy environment. 3It is the life supporting medium for all organisms.

3. It provides food , air , water and other important natural resources to the human beings Environmental problems : Deforestation activities , population growth and urbanization water Pollution due to effluents and smoke from industries, Scarcity.

Solution to environmental problems:

Reduce the waste matter and energy resources.

Recycle and reuse as many of our waste product And resources as possible. Avoid over exploitation of natural resources.

Minimise soil degradation and Protect the biodiversity of the earth. Reduce population and increase the economic growth our country.

Ethical guidelines on environmental protection:

1. The earth is the habitat of all living species and not of human beings alone.
2. Natural resources and energies are depleting fast. We must protect them.
3. Involve yourself in the care of the earth and experience nature.
4. Respect nature, you are a part of it.
5. Think of the global cause and act for local protection
6. Keep yourself informed about ecological changes and developments.
7. Observe austerity, reserve scarce resources for the future and the future generations.
8. We must be cooperative, honest, affectionate and polite to society and nature.

CLIMATE:

It is the average weather of an area. It is the general weather condition, seasonal variations of the region. The average of such conditions for a long period is called climate.

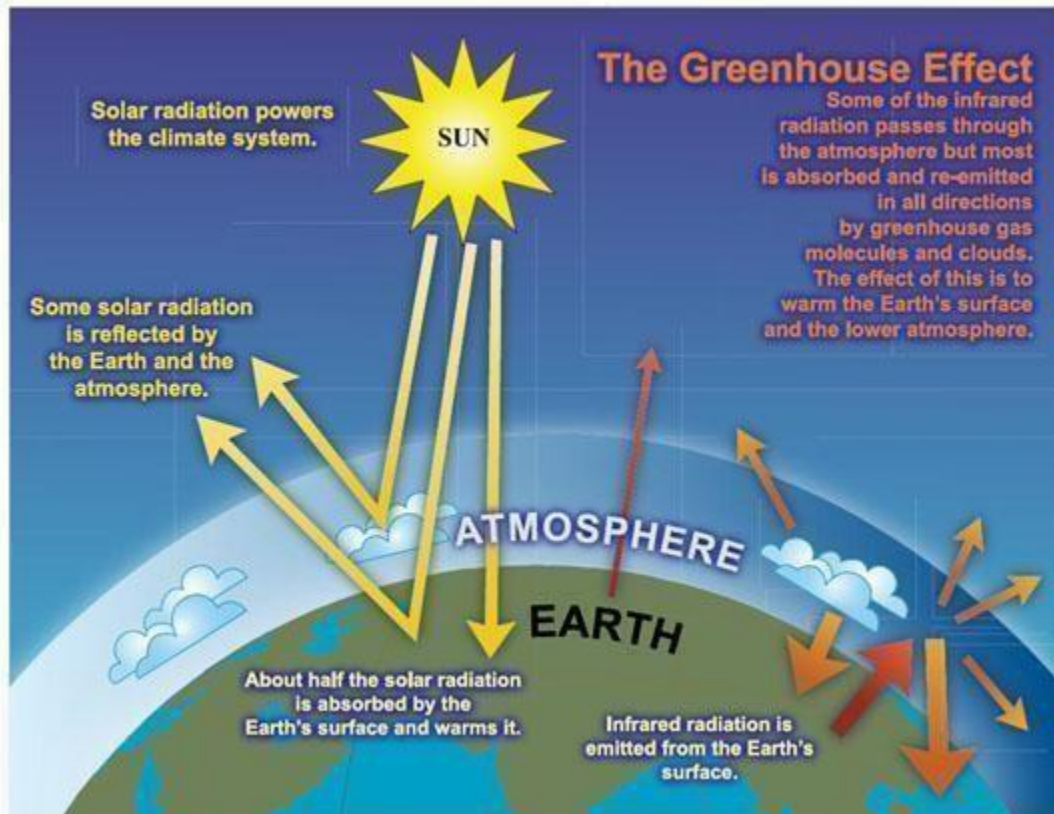
Causes of climate changes:

1. Presence of green house gases in the atmosphere Increases the global temperature.
2. Depletion of ozone layer increases the global temperature.

Effects of climate change:

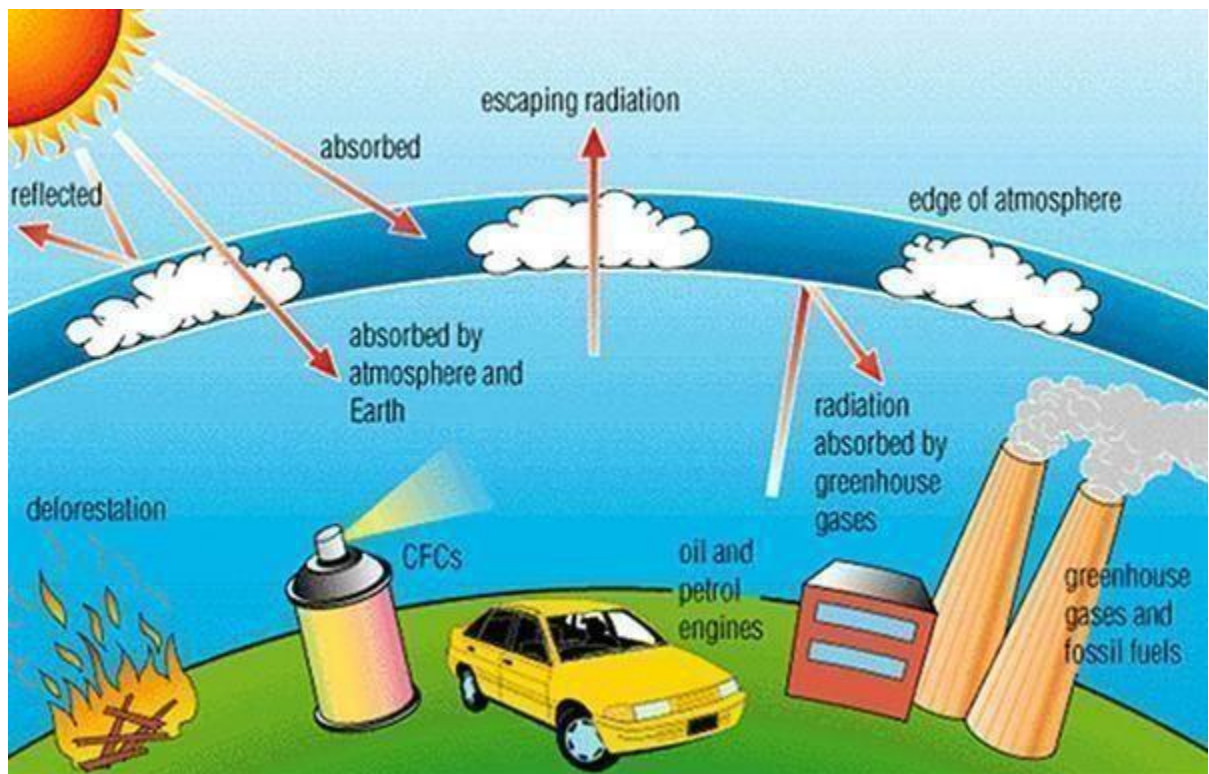
1. Small climate changes disturb agriculture which leads To migration of animals and human.
2. Climate change may upset hydrological cycle which results in floods and droughts in different parts of the world.
3. Global pattern of winds and oceans currents also gets disturbed by climate change.

Green house effect: Green house gases are CO_2 , Methane, Nitrous oxide NO_2 , CFC. Among these CO_2 is the most important green house gas. O_3 and SO_2 act as serious pollutants causing global warming. Progressive warming up of a gas surface due to blanketing effect of man made CO_2 atmosphere.



GLOBAL WARMING:

Green house gases in the atmosphere are transparent to light but absorb IR radiation. These gases allow sunlight to penetrate the atmosphere and are absorbed by the earth surface. This sunlight is radiated back as IR which is absorbed by gases. As a result the earth surface and lower atmosphere becomes warm. This is called global warming.



EFFECTS OF GLOBAL WARMING:

1. Sea level increases as result of melting and thermal expansion of ocean.
2. High CO₂ level in the atmosphere have a long term negative effect on crop production and forest growth.
3. Global rainfall pattern will change .Drought and floods will become more common. Raising temperature will increase domestic water demand.
4. Many plants and animal species will have a problem of adapting. Many will be at the risk of extinction, more towering verities will thrive.
5. As the earth becomes warmer the floods and drought becomes more frequent. There would be increase in water-borne diseases.

MEASURES TO CHECK GLOBAL WARMING:

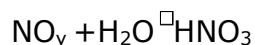
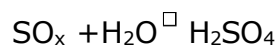
1. CO₂ emission can be cut by reducing the use of fossil fuel.
2. Plant more trees.
3. Shifting from coal to natural gas.
4. Stabilize population growth.
5. Remove efficiently CO₂ from smoke stacks.
6. Removal atmospheric CO₂ by utilizing photo synthetic algae.

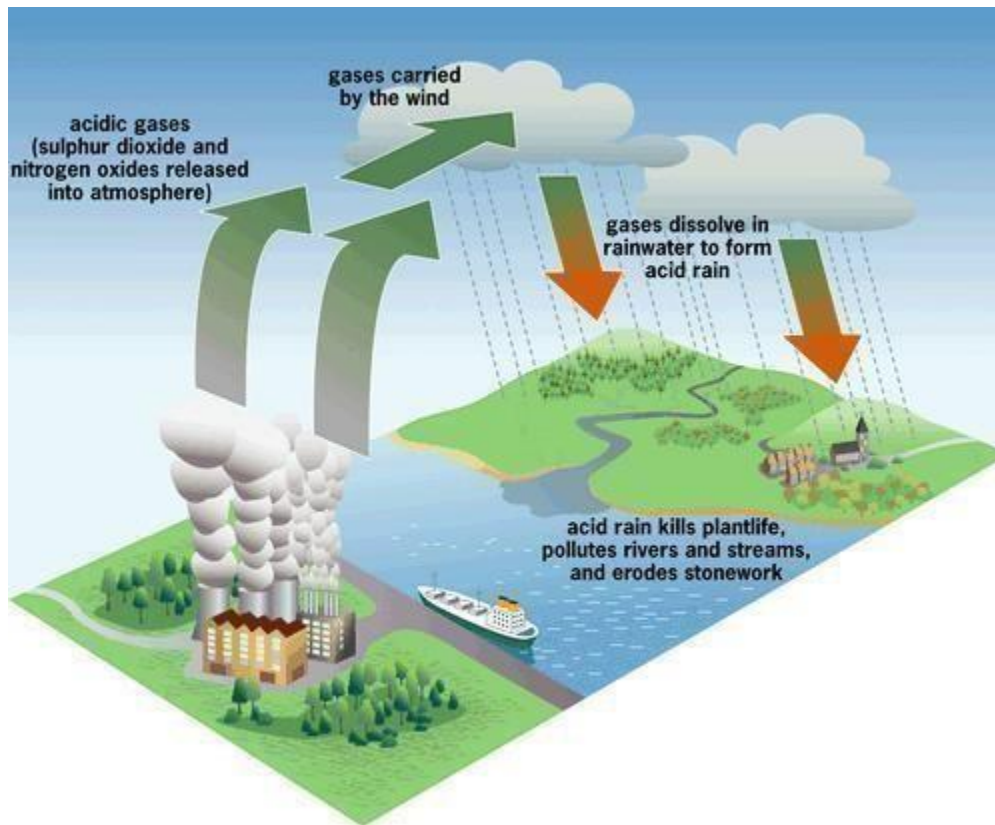
ACID RAIN:

Normal rain water is always slightly acidic (pH 5-5.6) because of CO₂ present in the atmosphere gets dissolved in it. Because presence of SO₂ and NO₂ gases as pollutants in the atmosphere. The pH of the rain is further lowered. This type of precipitation of water is called acid rain.

Formation:

Acid rain means the presence of excessive acids in the rain water. The thermal power plants industries and vehicles release NO₂ and SO₂ in to the atmosphere due to the burning of coal and oil. These gases reacts with water vapor in the atmosphere and from acids like HNO₃, H₂SO₄. These acids descends on to the earth as acid rain through rain water.





EFFECTS:

Effect on human being:

Human nervous system respiratory system and digestive system are affected by acid rain. It causes premature death from heart and lung disorders like asthma, bronchitis.

On building:

At present Taj Mahal in Agra is suffering due to SO_2 and H_2SO_4 fumes from Madras refinery. Acid rain corrodes houses, monuments, statues, bridges and fences.

Acid rain causes corrosion of metals.

Terrestrial and lake Ecosystem.

Reduce the rate of photosynthesis and growth in terrestrial vegetation.

Acid rain retards the growth of crops like beans potatoe ,carrot ,spinach. Acid rain rduces fish population ,black flies,mosquitoes ,deer flies occurs largely which causes number of complications in ponds rivers and lakes.

Activity of bacteria and other microscopic animals is reduced in acidic water. The dead materials are not rapidly decomposed.Hence the nutrients like N,P are locked up in dead matter.

Control of acid rain:

Emmision of No₂ and SO₂ from industries from power plants should be reduced by using pollution control equipments.

Liming of lakes nad soils should be done to correct the adverse effect of acid rain. In thermal points low sulphur content coal should be used.

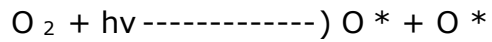
OZONE LAYER DEPLETION

Ozone gas is present in the atmosphere. It is highly concentrated at the stratosphere Between 10 to 50 Km above the sea level and is called as ozone layer.

Importance: O₃ protects us from damaging UV radiation of the sun. It filters UV- B radiation. Now days certain parts of O₃ layer is becoming thinner and O₃ holes are formed. Because of this more UV-B radiation reaches the earth's surface. UV -B radiation affects DNA molecules, causes damages to the outer cell of plants and animals.

It causes skin cancer and eye disease in human beings.

Formation of O₃ : It is formed in the atmosphere by photochemical reaction

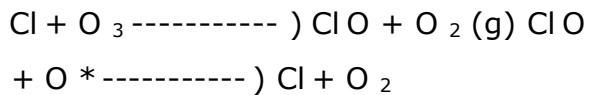


The atomic oxygen reacts with molecular O₂ to form O₃

$$\text{O}^* + \text{O}_2 + \text{M} \text{-----} \text{O}_3 + \text{M}$$

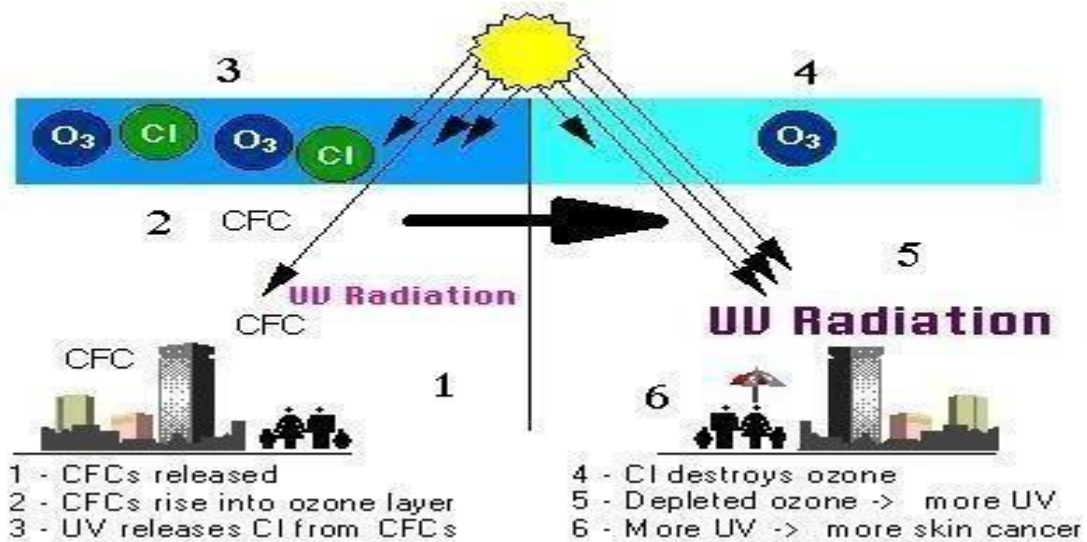
Where M = third body like nitrogen.

Causes of O₃ layer depletion : Refrigerators , air conditioners , aerosol sprays and cleaning solvents release CFC s into the atmosphere. CFCs releases chlorine which breaks O₃ to O₂



Each chlorine atom is capable of breaking several O₃ molecules . It is a chain reaction. 1% loss of O₃ results in 2% increase in UV rays reaching the earth surface .

Ozone depletion chemicals CFC , HCFC , BFC. Some times atmospheric sulfur dioxide is converted in to H₂SO₄ which increases the rate of O₃ layer depletion.



Effects ozone layer depletion:

Effects on human beings

1. UV rays causes skin cancer.
2. Increases the rate of non melanin skin cancer in fair colored people.
3. Prolonged expose to UV rays leads to actinia Katatities (slow blindness) and cataracts.

Effects on aquatic system :

1. UV rays affects phytoplankton , fish , larval crabs.
2. phytoplankton consumes large amounts of CO_2 .
3. Decrease in phytoplankton results in more amount of CO_2 in atmosphere. This contributes to global warming.

Control measures : Manufacturing and using of O_3 depleting chemicals should be stopped. Use of methyl bromide .which is a crop fumigant should be controlled. Replacing CFC s by other maerials which are less damage

NUCLEAR ACCIDENTS AND HOLOCAUST

Energy released—during a nuclear reaction is called nuclear energy. Nuclear fission and Nuclear fusion are used to prepare nuclear energy. During nuclear accidents large amount of energy and radioactive products are released into the atmosphere.

Types of nuclear accidents :-

Nuclear Test- Nuclear explosions –release radioactive particles and radioactive rays into the atmosphere.

Nuclear power plant accidents: Nuclear power plants located in seismic vulnerable area may cause nuclear accidents which releases radiation.

Improper disposal of radioactive wastes: Drums with radioactive wastes, stored underground rust and leak radioactive wastes into water, land and air.

Accidents during transport . Trucks carrying radioactive wastes (or) fuels in accidents. The major accident at a nuclear power plant is a core melts down.

Effects of nuclear radiation

1. Radiation affects DNA in cells.
2. Exposure to low dose of radiation (100to 250 rds) people suffer from fatigue, vomiting ,and loss of hair.
3. Exposer to high radation (400- 500 rds) affect bone marrow ,blood cells , natural resistance fail of blood clot.
4. Exposure to very high dose of radiation (10000rds) kills organisms by damaging the tissues of heart and brain.

Nuclear Holocaust : -Destruction of Biodiversity by nuclear equipments and nuclear bombs is called nuclear holocaust.

Effects of nuclear holocaust.

Nuclear winter, Nuclear bombardment will cause combustion of wood , plastics , forests etc.

Large quantity of soot will be carried out into the atmosphere.

Black soot absorbs all UV radiation and will not allow the radiation to reach the earth. Therefore cooling will result. This reduces evaporation of water. In stratosphere there won't be significant moisture to rain out the black soot. Due to nuclear explosion a process opposite to global warming will occur. This is called Nuclear winter.

Nuclear holocaust in Japan

In 1945 two nuclear bombs were dropped in Hiroshima and Nagasaki in Japan. About 100,000 people were

killed and the cities were badly destroyed. This explosion emitted forceful neutrons and gamma radiation.

Radioactive Strontium liberated in the explosion replaced calcium in the bones. Large scale bone deformities occurred in the people of these cities.

WASTE LAND RECLAMATION

Waste land. The land which is not in use is called waste land. Waste land is unproductive, unfit for cultivation and grazing etc. 20% of the geographical area of India is waste land.

Types of waste land:

1. Uncultivable waste land.
2. Cultivable waste land.

Uncultivable waste land: Barren rocky areas, hilly slopes, sandy deserts.

Cultivable waste land: These are cultivable but not cultivated for more than 5 years. Ex Degraded forest land.

Causes of waste land formation:

1. over exploitation of natural resources.
2. Industrial and sewage wastes.
3. Due to soil erosion, deforestation, water logging, salinity etc.
4. Mining activities destroy the forest and cultivable land.

Objects of waste land reclamation:

1. To prevent soil erosion, flooding and land slides.
2. To avoid over exploitation of natural resources.
3. To improve the physical structure and quality of the soil.
4. To conserve the biological resources and natural ecosystem.

Methods waste land reclamation:

Drainage: Excess water is removed by artificial drainage. This is for water logged soil reclamation.

Leaching: Leaching is a process of removal of salt from the salt affected soil by applying excess amount of water. Leaching is done by dividing the field into small plots. In continuous leaching 0.5to 1.0cm

Water is required to remove 90% of soluble salts.

Irrigation practices: High frequency irrigation with controlled amount of water helps to maintain better availability of water in the land. Application of green manure and bio fertilizers improves saline soil.

Application of gypsum: Soil sodality can be reduced with gypsum. Ca of gypsum replaces sodium from the exchangeable sites. This converts clay back into calcium clay.

Social Forestry programme: These programs involve strip plantation on road, canal sides and degraded forest land etc.



COSUMERISM AND WASTE PRODUCTS

The consumption of resources by the people is called consumerism. It is related to both increase in population size as well as increase in our demand due to change in life style. If needs increase the consumerism of resources also increases.

TRADITIONAL FAVOURABLE RIGHTS OF SELLERS

- 1.** The right to introduce any product.
- 2.** The right to change any price.
- 3.** The right to use incentives to promote their products

IMPORTANT INFORMATION TO BE KNOWN TO BUYERS

1. Ingredients of the products.
2. Manufacturing date and expiry date .Whether the product has been manufactured against an established law of nature or involved in right variation.

Objectives of consumerism.

1. It improves the right and powers of buyers.
2. It involves making manufacturer liable for the entire life cycle of a product
3. It force the manufacturer to reuse and recycle the product after usage.
4. Active consumerism improves human health and happiness and also it saves resources. Sources of wastes are agriculture, mining, industrial and municipal wastes.

Example for waste products. It includes paper, glass, plastic, garbage, food waste, Scrap, construction and factory wastes.

E- waste : Electronic equipments like computer, printers, mobile phones, calculator etc After usage thrown as waste.

Effects of waste: Waste from industries and explosives are dangerous to human life. Dumped wastes degrade soil and make it unfit for irrigation.

E-wastes contain more than 1000 chemicals which are toxic and cause environmental Pollution. In computers lead is present in monitors, cadmium in chips and cathode ray tube , pvc in cables. All these cause cancer and other respiratory problems if inhaled for long long periods.

Plastics are non-degradable and their combustion produces many toxic gases.

Factors affecting consumerism and generation of wastes:

People over population –Over population cause degradation of sources, poverty and premature deaths. This situation occurs in less developed countries (LDC's).In LDC's the percapita consumption of resources and waste generation are less.

Consumption Over population: It occurs when there are less people than the available Resources . due to luxurious life style per capita consumption of resources is very high. Consumption is more and waste generation is more. Environment is also degraded.

ENVIRONMENTAL LEGISLATION AND LAWS

Water (prevention and control of pollution) Act.1974.

This act provides for maintaining and restoring the sources of water. It also provide for preventing and controlling water pollution.

Features of water act.

1. This act aims to protect the water from all kind of pollution and to preserve the quality of water in all aquifers.
2. The act further provides for the establishment of central board and state boards For prevention of water pollution.
3. The states are empowered to restrain any person from discharging a pollutant (or) sewage or) effluent into any water body with out the consent of the board.
4. The act is not clear about the definition of pollutant, discharge of pollutant Toxic pollutant.

State pollution control board

The consent of this board is needed

1. To establish any industry or any treatment and disposal system or any extension or addition which likely discharge Or trade effluent into a stream or well or river or on land.
2. To use any new or altered outlet for the discharge of sewage.
3. To begin to make any new discharge of sewage.

Act also empowers the state board to order closure or stoppage of supply of Electricity, water or any other service to the polluting unit.

AIR PREVENTION ACT 1981

This act was enacted in the conference held at Stock Holm. It envisages the establishments Of central and State control boards to monitor air quality and pollution control.

Important features:

1. The central board may lay down the standards for quality of air.
2. The central board co-ordinates and settle the disputes between state boards.
3. The central board provides technical assistance and guidance to state boards.
4. The state boards are empowered to lay down the standards for emission of air pollutants from industries or other resources.
5. The state boards are to examine the manufacturing processes and control equipment for for the prescribed standards.
6. The direction of central board is mandatory on state boards.
7. With out the consent of the central board operation of an industrial unit is prohibited in heavily polluted area.
8. Violation of law is punishable with imprisonment for three months or fine of Rs 10000 or both.

This act applies to all pollution industries. This act empowers the state board to order closure of any industrial unit or stoppage of water supply or stoppage of electricity.

FOREST (CONSERVATION) ACT 1980

This act is enacted in 1980. It aims to arrest deforestation. This act covers all types of Forests including reserved forests, protected forests and any forest land.

IMPORTANT Features of the act :

1. The reserved forests shall not be diverted or dereserved without the permission of central govt.
2. The forest land may not be used for non-forest purposes.
3. This act stops illegal activities within forest area.

Features of amendment act of 1988

1. Forest departments are forbidden to assign any forest land by way of lease or to any private person or NG body for re- afforestation.
2. For re-afforestation clearance of any forest land is forbidden.
3. The division of forest land for non -forest uses is punishable.

WILD LIFE ACT 1972.

This act was amended in 1983, 1986, and 1991. This act is aimed to protect and preserve all animals and plants that are not Domesticated. India has 350 species of mammals, 1200 species of birds and about 20000 Known species of insects. Some of them are listed as endangered species in wild life protection act. Wild life is declining due to human action. Wild life products like skins, furs, feathers, Ivory etc. have decimated the population of many species. Wild life population monitored regularly and management strategies formulated to protect them.

Important Features

1. The act covers the rights and non- rights of forest dwellers.
2. It allows restricted grazing in sanctuaries but prohibits in national parks.

3. It also prohibits the collection of non timber forest.

4. The rights of forest dwellers recognized by forest policy of 1988 are taken away by Amended wild life act of 1991.

ENVIRONMENT (PROTECTION) ACT 1986

This act empowers the central govt. to fix the standards for quality of air, water, soil, and noise. The central govt. formulates procedures and safe guards for handling of hazard substances.

Important features: 1. this act empowers the govt. to lay down procedures and safe guards for the prevention of accidents which cause pollution and remedial measures if accidents occur.

2 The govt.has the authority to close or prohibit or regulate any industry or its operation if

The violation of provisions of the act occurs.

3. Violation of the act is punishable with imprisonment for 5 years or fine of one lakh or both.

4. If violation continues an additional fine of Rs5000 per day may be imposed for entire period of Violation of rules.

5. The act empowers the officer of the central govt.to inspect the sight or the plant or machinery for preventing pollution and to collect samples of air , water, soil and other materials from any

Factory or its premises for testing.

PUBLIC AWARENESS

In order to conserve our environment each and every one must be aware about our environment problems and objectives of various environmental policies at natural and local level.

Objectives of public awareness:

1. To create awareness among rural and city people about ecological Imbalance, local environment and technological development.
- 2 To organize meetings, tree plantation programs, group discussion on development, exhibitions.
3. To focus on current environment problems and situations.
4. To train our planners, decision makers, politicians and administrators.
5. To eliminate poverty by providing employment that over comes the basic environmental issues.

METHODS TO CREATE ENVIRONMENTAL AWARENESS

1. Environmental education must be imparted to the students in schools and colleges.
2. Media like TV Radio and cable net work can educate the people on environmental issues through Cartoons, documentaries, street plays.
3. Cinema about environmental education should be prepared and screened in theatres compulsorily .This films may be released with tax free to attract the public.
4. All the news papers and magazines must publish the environment related problems.
5. Special audio visual and slide shows should be arranged in public places.
6. Voluntary organizations like NCC, NSS, and ROTRACT Club should be effectively utilized for creating environmental awareness.
7. Arranging competitions like story and essay writing painting competition on environmental issues for student as well as public. Attractive prizes should be awarded for the best effort.
8. Public leaders cine actors and popular social reformers can make an appeal to the public about the urgency of environmental protection.

UNIT 7

HUMAN POPULATION AND THE ENVIRONMENT

Population Growth, Variation Among Nations – Population Explosion – Family Welfare Programme – environment and Human Health – Human Rights – Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.
Field Study of Local Area to Document Environmental assets – River/Forest/Grassland/Hill/ Mountain.
Field Study of Simple Ecosystems – Pond, River, Hill Slopes, etc
Field Study of Local Polluted Site – Urban/Rural/Industrial/Agricultural

Human population and the Environment

Population:- Group of individuals belonging to the same species which live in a given area at given time.

Population density:- Number of individuals of the population per unit area ® per unit-volume.

Parameters effecting population:-

Birthrate (OR) Natality:- Number of live births per 1,000 people in a population in a given year.

Death Rate (OR) Mortality:- Number of deaths per 1000 people in a population in a given year

Immigration:- It denotes the arrival of individuals from neighboring population.

Emigration:- It denotes the disposal of individuals from the original population to new areas.

Rate = $\frac{\text{Number of births}}{\text{Number of years}}$

Mortality = $\frac{\text{Number of babies died}}{\text{Number of babies born} \times \text{Number of year}}$

h rate = $\frac{\text{Change of population}}{\text{Number of year}}$

Population Growth :- Results from the difference between the rate of birth and death. In 1980 the global population was about 1 billion people. In 1930 it reached 2 billion. In 1975 it reached 4 billion with in 45 years. Now the population in 6 billion. It reaches 10 billion by 2050 as per the world Bank calculation.

Causes:- 1. Due to decrease in death rate and increase in birth rate.

2. Availability of antibiotics, immunization increased food production, clean water and air, decreases the famine related deaths and infant mortality.

3. The poverty and illiteracy lead controlled growth of population.

4. Child Marriages

5. People's superstitions. People believe that it is because of God's grace.

Characteristics of P.G.:-

Exponential growth:- Population growth occurs exponentially like 10 , 10^2 , 10^3 , 10^4 etc., Which shows the dramatic increase in global population in the past 160 years.

Doubling Time:- Time required for the population to double its size at a constant annual rate. It is calculated as follows:-

$T_d = 70 / r$ When $r =$ annual growth rate

If a nation has 2 % annual growth its population will double in 35 years.

Infant Mortality:-

Percentage of infant died out of those born in one year. This rate is decreased in the last 50 years. This differs widely in developing and developed countries.

Total fertility rates (TFR):

Average number of children delivered by a woman in her life time. The TFR varies from 2 in developed to 4.7 in developing countries.

This ratio should be fairly balance in the society.

Male – female ratio has been upset in many countries including China - India. In china the ratio of girls and boys is 100 – 140.

Demographic transition:

P.G. is redacted to economic development. The birth rate and death rate fall due to improved living conditions. This results in low population growth. This phenomenon is called demographic transition.

Variation of population among Nation:

At present the world's population has crossed 6 billions. Less developed countries (Africa, Asia, S.A) have 80% population while developed countries have only 20%.

In most developed countries like USA, Canada, Australia population increases by less than 1%. But in less developed countries the population increases by more than 1% / year.

Kenya is the fastest population growing country in the world. When 20 million are residing.

China & India's population was above 1000 million in 2000 years. Its share is 1/3 of the world population.

Europe and N.H. accounts for 14% of world population.

Variation of pollution based on Age structure

Age structure of population can be classified into 3 classes.

Pre- productive population (0 – 14 years)

Reproductive population (15 - 44 years)

Post reproductive population (Above 45 years)

Variation of population is now explained based on the above three classes.

Pyramid shaped Variation of population (increase)

Eg. In India, Bangladesh, Ethiopia, Algerian Reproductive population is more in companion to pre reproductive population and post productive population. Hence the population increases.

Bell shaped variation of population:

Eg: In France, USA, UK, Canada etc., pre reproductive population and reproductive population is more (OR) less equal. Hence population growth in stable.

Urn shaped variation of populations

Eg: In Germany, Italy, Sweden,

In Japan pre productive age group population is smaller than the reproductive age group population. In the next 10 years. The number of people in reproductive age group less than before resulting in decrease of population.

Population Explosion:

The enormous increase in population due to low death rate and high birth rate is called as population expansion.

Doubling time: The number of years needed for a population to double in size. The doubling time varies from country to country.

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an	

Population growth is higher in less developed countries.

Cause of population explosion:

1. Invention modern medical facilities, reduces the death rate and increases birth rate, which leads to population explosion.
2. Increase of life expectancy is another important reason for population explosion. Eg:- In 1956, the average life expectancy of the human beings was 40 years. But now it is 61 years.
3. Illiteracy is one of the reasons for the population explosion.

Effect of population explosion (OR) environmental and social impacts of growing population

Poverty:

1. Population explosion leads to environmental degradation.
2. Population explosion causes over exploitation of natural resources. Hence there will be a shortage of resources for the future generation.
3. Increase in population will increase diseases, economic inequality and command wars.
4. Forests, grass lands are under threat.
5. The main reason for the growing unemployment in growing population.
6. Educating vast population is a very big task.
7. Population explosion is the main cause for pollution of air, land, water and noise.
8. Disposal of plastics and wastages is another problem of over population.
9. Scarcity of fuel is also due to population explosion.

Family welfare programmes

Family welfare programme was implemented by Govt. of India as a voluntary programme. It is a policy of growth covering human health, family welfare children and women's right.

Objectives:

1. Slow down the population explosion by reducing fertility.
2. Pressure on the environment, due to over exploitation of natural resources is reduced.

Population stabilization Ratio

The ratio is derived by dividing crude birth rate by crude death rate.

Developed countries: The stabilization ratio of developed countries is 1. indicating zero population growth.

Developing countries:

The ratio of developing countries is rearing 3 which is expected to lower down by 2025. Stabilization in developing countries is possible only through family welfare programmes.

Family planning Programme

It provides educational and clinical services that help couples to choose how many children to have and when to have them. Family planning programme provides information on birth spacing, birth control and health care for pregnant women and infants. It also reduced the number of legal and illegal abortions per year and decreased the risk of death from pregnancies.

Objectives:

1. Reduce infant mortality rate to below 30 / 1000 infants.
2. Achieve 100% registration of births, deaths, marriage and pregnancies.
3. Encourages late marriages and late child bearing.
4. Encourages breast feeding.
5. Enables to improve woman's health education, employment.
6. Constrain the spread of AIDS / HIV.
7. Prevent and control of communicable diseases.

Fertility control methods

Traditional methods

It includes taboos and folk medicine.

Modern methods

It includes birth control techniques like mechanical barriers, surgical methods, chemical pills and physical barriers to implantation. More than 100 contraceptive methods are on trial.

Family planning programme in India

1. In 1952 India started family planning programme.
2. In 1970 Indian govt. forced FP campaign all the over country.
3. In 1978 govt. legally raised the minimum age of marriage for men from 18 to 21 and for women 15 to 18 years.
4. In 1981 census report showed there is no drop in population. Hence funding for FP programme has been increased.

Environment & human Health

Healthy person:- Physically fit person with out suffering any disease is called a healthy person.

Disease:- Harmful changes in the body's condition by nutritional, biological, chemical (or) psychological factors are called diseases.

Important Hazards and their health effects refer – bort

Chemical Hazards and their health effects refer T.B.

Biological Hazards and their health effects Refers T.B.

Preventive measures:

1. Always wash your hand before eating.
2. Cut short and clean your nails systematic.
3. Drinking chemically treated and filtered water.
4. Eat food always in hot condition.
5. Wash the vegetables and fruits a with clean water before cooking.
6. Avoid plastic containers and Al vessels.

7. Do physical exercise to have proper blood circulation.

Human Rights

Human rights are the fundamental rights possessed by human beings irrespective caste, nationality, sex & language.

The aim of Govt. is to ensure happiness to the entire citizen with equal rights.

Under the Indian constitution the following fundamental rights have been guaranteed to human beings.

1. Human right to freedom
2. Human right to property
3. Human right to freedom of religion.
4. Human right to culture and education.
5. Human right to constitutional remedies
6. Human right to Equality
7. Human right to against exploitation.
8. Human right to food and environmental
9. Human right to health

1. Human rights to freedom

Every citizen has the freedom to express his view freely.

Citizen can assemble at any place to express their views.

Freedom to form unions (or) associations.

Freedom to slant any profession.

Indian Constitution

Indian constitution provides for civil, social, cultural, educational and political rights.

Article 14 – equality before law.

Article -15

Prohibits discrimination on the ground of race, religion caste, sex (or) place of birth.

Article 16

Provides equal opportunity for all citizens in regarding to employment.

Article 19

Provides for freedom of speech and expression, forming association and union.

Article – 20

Protection from connection except in accordance with the law of the land.

Article – 22 – lays down the rights of a person in custody.

Article – 24 – prohibits exploitation of labour children.

Article – 25 – grants freedom to profess, practice and propagate a religion of one's choice.

Value education

Education is nothing but learning through which knowledge about a particular thing can be acquired with the help of our knowledge and experience we can identify our value to understand ourselves and our relationship with other and their environment.

Types of Education:

Formal Education:- (In this all learning process are self related). All people will read write, will get good jobs and take with any problem with the help of formal education.

Value Education:- It is an instrument used to analyse our behavior and provide proper direction to our youth. It teaches the youth the distinction between right & wrong, to be helpful loving, generous and tolerant.

Eg:- If a person is highly, Qualified and well settled in life, something he does not know how to behave with his environment.

Value based environmental education

The provides knowledge about the principle of ecology, fundamental of environment and biodiversity. It creates sense of duty to care for natural resources and to manage them in sustainable key.

Objectives:

1. Improve integral growth of human being.
- 2.To create altitudes and improvement towards sustainable life style.
- 3.To increase awareness about our national history, cultural heritage, constitutional rights, national integration.
- 4.To understand (about the our) natural environment in which how land, air and water are interlinked.
- 5.To know about various living and non living organism and their interaction with the environment.

Types of values:

1. Universal values (or) social values:

These values tells about the importance of the human conditions. These are reflected in life, joy, love, tolerance, truth etc.

2. Cultural values:

These values various with respect to time and place. These are concerned with rights & wrong, good & bad true & false and behavior of human beings. It is reflected in language, education, law, economics, philosophy etc.

3. Individual values:

These are personal principles and the result of individual personality and experience parents & teachers are the main key to shape and individual values. I t is reflected in individual goods, relationship, commitments.

4. Global values:

Human civilization is a part of the planet. Nature and natural pheromone on the earth are interconnected and inter-linked with special bonds of harmony. If this harmony disturbed any where leads to catastrophic results due to ecological imbalance.

Aids / HIV – Discover in 1983. Source of the virus is not been identified spread through African monkey. Through vaccine program – spread by small pox vaccine programme of Africa. Hepatitis – B Viral vaccine legmy and new York.

World scenario

90% from developing countries. 13% of world's population live is Africa. Almost all states & African countries were affecters HIV. India ranks 2nd in the world with 5 million affects people.

Scenario in India:

Large number of infected people are in Maharastra & Tamil Nadu followed by Delhi, UP, Karnataka & Goa. Till sept. 2003 24,667 cases are found in Tamil Nadu.

Smog:- Mixture of smoke from coal combustion and fog in suspended droplets form photochemical smog cause irritation to eyes and lungs (ii) many damage plants (iii) Irritation to nose & throat (iv) asthma

Role of IT in Environment

IT plays a vital role in the field of environment education. IT means collection, processing, storage and dissemination of information. The internet facilities, information through satellites, www and geographical information provides up to date information on various aspects of environment, weather.

Remote sensing

It refers to any method which can be used to gather information about an object without coming in contact with it. Gravity, magnetic, electro magnetic forces could be used for remote

sensing. Remote sensing covers various disciplines from laboratory testing to astronomies. Now remote sensing is used to denote identification of earth features by detecting the characteristic electro magnetic radiation. That is reflected by the earth.

Components of a remote sensing system

The system consists of a **sensor** to collect radiation. Other important parts are a **platform**, an **aircraft**, a **balloon**, **rocket and satellite**.

The information received by the sensor is suitably manipulated and transported back to earth. The data's are reformed and processed on the ground to produce photographs, computer compatible magnetic tapes and digital storage medium.

Applications

1 Agriculture: In India agriculture provides livelihood of 70% of population and contributes to about 35% of net nation product. We require optimal management of land and water resources along with high yielding variety seeds, fertilizer input.

Remote sensing can provide valuable information for land and water management.

2. Forests: Remote sensing provides information clearly on the type, density and extent of forest cover, wood volume and biomass, forest fire, encroachment etc.

3. Land cover: Spatial information on land is required at different scales depends upon use remote sensing data is converted to map. The spatial resolution plays a role on the scale of mapping.

4. Water resources: Remote sensing data has been used in many application related to surface water body mapping, ground water targeting, wet land, flood monitoring, reservoir sedimentation, water quality monitoring etc. One of the most simple applications is inventorying surface water body.

DATABASE

It is the collection of inter related data on various objects. In the computer the information of database is arranged in a systematic manner.

Applications: I The ministry of environment and forest. They are compiling database on various biotic components. Database is also available for diseases likes HIV | AIDS. Malaria, Fluorosis.

National Management Information System (NMIS) : They compile database on R & D Projects along with information about research scientists and personnel involved. Environmental Information System : It functions in 25 centres all over the country.

They generate net work of database in areas like pollution control, remote sensing, biodiversity, and desertification.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

It is a technique of superimposing various thematic maps using digital data on large Number of inter related aspects.

Applications: Different thematic maps having digital information on water resources,

Soil type, forest land, crop land, grass lands are superimposed on a layered form in computer using soft ware.

Interpretation of polluted zones, degraded lands can be made on GIS base.

3. GIS can be used to check unplanned growth and related environmental problems.

SATELLITE DATA:

It helps in providing correct and reliable information forest cover

Provides information of monsoon, ozone layer depletion Smog etc.

Helps in discovering reserves of oil, minerals.

WWW:

More current data is available on www on line learning centre.

Www .mhhe.com \ environmental science.

Multimedia Digital content manager (DCM) in the form of CD ROMS.

Application of computers in the field of Environment & human health:

1. Unknown parameters can be stimulated by computer techniques
2. EIA (Environmental Impact Assessment) problems can be analyzed
3. Inventories of emission sources are compiled and maintained
4. Net-work analysis, statistical analysis and the status of environmental pollutions can be highlighted
5. Comprehensive administrative system can be developed by using computer network techniques.
6. Remote sensing-Graphical Interface System are useful for coral reef mapping and ocean resources. They are also useful to access the loss of biodiversity/hot spots etc.

IMPORTANT QUESTION & ANSWER

1. Write short note about Human Rights

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1. What is Value based environmental education

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Objectives:

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interlinked.

5. To know about various living and non living organism and their interaction with the environment.

2. Write Human population and the Environment

Population:- Group of individuals belonging to the same species which live in a given area at given time.

Population density:- Number of individuals of the population per unit area ® per unit-volume.

Parameters effecting population:-

Birthrate (OR) Nationality:- Number of live births per 1,000 people in a population in a given year.

Death Rate (OR) Mortality:- Number of deaths per 1000 people in a population in a given year

Immigration:- It denotes the arrival of individuals from neighboring population.

Emigration:- It denotes the disposal of individuals from the original population to new areas.

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8 WRITE EFFECTS OF GLOBAL WARMING:

- 1 Sea level increases as result of melting and thermal expansion of ocean.
- 2 High CO₂ level in the atmosphere have a long term negative effect on crop production and forest growth.
- 3 Global rainfall pattern will change .Drought and floods will become more common. Raising temperature will increase domestic water demand.
- 4 Many plants and animal species will have a problem of adapting. Many will be at the risk of extinction, more towering verities will thrive.
- 5 As the earth becomes warmer the floods and drought becomes more frequent. There would be increase in water-borne diseases.

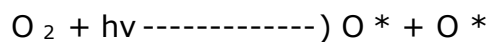
9. WRITE SHORT NOTE ABOUT OZONE LAYER DEPLETION

Ozone gas is present in the atmosphere. It is highly concentrated at the stratosphere Between 10 to 50 Km above the sea level and is called as ozone layer.

Importance: O₃ protects us from damaging UV radiation of the sun. It filters UV- B radiation. Now days certain parts of O₃ layer is becoming thinner and O₃ holes are formed. Because of this more UV-B radiation reaches the earth's surface. UV -B radiation affects DNA molecules, causes damages to the outer cell of plants and animals.

It causes skin cancer and eye disease in human beings.

Formation of O₃ : It is formed in the atmosphere by photochemical reaction

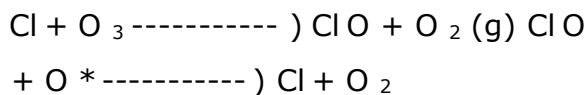


The atomic oxygen reacts with molecular O₂ to form O₃

$$\text{O}^* + \text{O}_2 + \text{M} \text{-----} \text{O}_3 + \text{M}$$

Where M = third body like nitrogen.

Causes of O₃ layer depletion : Refrigerators , air conditioners , aerosol sprays and cleaning solvents release CFC s into the atmosphere. CFCs releases chlorine which breaks O₃ to O₂



Each chlorine atom is capable of breaking several O₃ molecules . It is a chain reaction. 1% loss of O₃ results in 2% increase in UV rays reaching the earth surface .

10. Write short note about rain water harvesting

Rainwater harvesting. It is a technique of collecting and storing rain water for use in non-monsoon periods. In the present age, concrete houses, well-built roads, footpaths and well –concreted courtyards have left few open grounds. With the decrease in natural forest cover, increase in concrete jungles and the decrease in exposed earth; very little open ground is left for water to soak in and thereby increase the ground water table. So, artificial recharging of the ground water is extremely essential. It is done through rain water harvesting. For the purpose, rain water is collected at the roof top or in an open well and then carried down for immediate use or it is directed into the aquifer.