UNIT-I

UNIT – I: Multidisciplinary nature of Environmental Science and Ecosystems

Definition, Scope and Importance – Sustainability: Need for public awareness-Human population and Environment.

Ecosystems: Concept of an ecosystem. - Structure and function of an Ecosystem -Types of EcosystemForest,

Grassland, Desert and Aquatic Ecosystems – Food chains, food webs and ecological pyramids

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

ENVIRONMENT:

The term environment is derived from the <u>French</u> word <u>'environner'</u> which means surroundings or encircle.

All the biological and non biological things, surrounding an organism are included in environment.

Environment is sum total of water, air, land and their inter relationships among themselves and also with human beings and other living organisms.

Environment includes all the physical and biological surroundings and their interactions.

Environment is a complex system that includes physical, chemical, biological, social and cultural elements; all these elements are interlinked to each other in a complicated manner similar to spider web.

TYPES OF ENVIRONMENT:

Environment is divided into two categories

1. Natural environment

2. Anthropogenic environment

<u>Natural environment</u>: it includes air, water, soil, forest, wildlife, flora, fauna etc. It operates through a self regulating mechanism. The natural environment is never static. The changes may be negligible or may be drastic. These changes may be either beneficial or harmful to the living organisms in the environment. Natural environment is divided into four types.

- **1. Lithiosphere:** It includes solid part of the earth's crust. It has two parts, crust and upper mantle. Crust includes rocks, minerals and soil. Below the crust is the mantle. It is the earth's interior. It has upper layer and lower layer.
- **2. Hydrosphere:** It includes all the water on earth. Most of the water is in the oceans. The availability of water on earth is a unique feature. It is responsible for the existence of life on the planet. The presence of water on earth gives it the name blue planet. This is the largest part of the environment. Due to range of surface temperature and pressure, water exists in all three parts. Solid (ice), liquid (water), gas (water vapour). Hydrosphere has two parts. The part which contains salt water is called saline or marine water consisting of oceans, sea, etc. The part which contains fresh water consisting of rivers, lakes, ponds, canals, etc. Many living organisms live in water they are called aquatic life.
- **3. Atmosphere:** The layer of gases surrounding earth is called atmosphere. The atmosphere is composed of several distinct layers such as troposphere, stratosphere, mesosphere, and ionosphere. All these layers contain different types of gases.
- **4. Biosphere:** It is the life zone of earth and includes all living organisms. Biosphere includes air, land, water, plants, animals which life occurs. The biosphere can be divided into distinct eco system

ANTHROPOGENIC ENVIRONMENT: It includes components that have been introduced by human beings, depending on their needs and requirements. It deals with man-environment relationship and man with components. These may refer to alternations of surroundings for industrial, commercial, agricultural or housing purposes.

All these lithosphere, hydrosphere, atmosphere, biosphere and anthrosphere are interlinked and are interdependent on each other. Such environment becomes a highly complex structure.

Another way to classify the environment is,

PHYSICAL ENVIRONMENT: The physical environment includes the matter which the universe is made of and excludes the biotic components. Ex: light, humidity, soil, rain, solar energy, temperature, etc.

<u>CHEMICAL ENVIRONMENT</u>: It includes all the chemical components of earth. Ex: gases, acids, water, inorganic and organic substances

BIOLOGICAL ENVIRONMENT: It includes all life on earth. It covers all living organisms found on earth. Ex: bacteria, viruses, microbes, alge, herbs, mammals, etc.

COMPONENTS OF ENVIRONMENT

ABIOTIC COMPONENTS: Non-living components of an ecosystem is called abiotic components. Abiotic components are essential for the living world, as life cannot exist without factors like sunlight, water, air etc. The quality of abiotic environment is critical factor of life. Changes in the abiotic environment can affect the conditions of living organisms and vice versa.

Ex: air, water, soil, rocks, and minerals and climate conditions like light, temperature, wind

<u>BIOTIC COMPONENTS:</u> Living components of environment is biotic components. Ex: microbes, plants, animals and human beings. The biotic components of the environment are producers (autotrophs) and consumers(Heterotrophs)

Producers: This group of organisms are able to manufacturing their own food itself. For example green plants and alge. These plants absorbs solar energy and with the help of chlorophyll, they prepare their own food in the form of sugars is called photosysthesis and plants are called autotrophs. Bacteria utilize the oxidation of hydrogen sulphide, ammonium and ferrous ion as an energy source to manufacture their food by chemosysthesis and are known as chemoautotrophs.

<u>Consumers:</u> These groups of organisms are not capable of manufacturing food and depend upon autotrophs. Example: animals, fungi, protozoa, most of bacteria.

Heterotrophs are further classified as Herbivores, carnivores, omnivores and decomposers depending on their food habits.

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Environmental studies are very closely related to many branches; it includes **science**, **humanities**, **commerce**, **geography and other disciplines**

BIOLOGICAL SCIENCES (LIFE SCIENCES)

It is impossible to study the environment, without acquiring knowledge of the living organisms.

It is important to study the basic concepts of <u>botany</u>, <u>zoology</u>, <u>microbiology</u>, <u>bio-technology</u>, <u>genetics</u> <u>etc.</u> to study the different aspects of environment and their inter relationships i.e. these sciences are helpful in understanding the <u>biotic components</u> and their interactions and with abiotic components.

E.S. Are very closely related to many branches, it includes science, humanities, commerce, geography and other disciplines

PHYSICAL SCIENCES:

<u>Physics, chemistry, atmospheric science, Oceanography and geography</u> are useful for understanding the physical and chemical structure of <u>abiotic components</u> of environment and <u>mass and energy transfer.</u>

Global warming, ozone layer, acid rain problems, pollution problems can be understood by the knowledge of chemistry

Energy transformation, bio-geochemical cycles, ecosystem require knowledge input from physics.

Environmental studies are linked to Bio physics, geophysics, bio chemistry etc.

SOCIAL SCIENCES: Human beings to relate and understood the implication of environment in human welfare and sustenance

<u>MATHS:</u> Mathematics, statistics, computer science serve as effective tools in environmental modeling and management

LAW: Provide guidelines and legal measures for effective management and protection of environment.

TECHNOLOGY: Civil Engineering, Chemical Engineering and various technologies and nano technology provide the technical solutions to waste management, control of pollution and development of cleaner technologies. These are important for protection of environment.

<u>MANAGEMENT:</u> Economics, management, sociology provides the inputs for dealing with <u>socioeconomic aspects</u>, <u>associated with various development activities.</u> Geography, geology, space science, population studies, sociology, remote sensing etc. Combines with both the physical and social sciences, these provide <u>skills and conceptual frame works.</u> These are needed to understand the complex processes of the environment

GEOGRAPHY: geography is an area of study relevant to anyone who is concerned with the relationship between <u>society and the environment</u>.

<u>Clear knowledge of all the sciences is required to understand the problems related to environment and find the solutions</u>

IMPORTANCE OF ENVIRONMENTAL STUDIES

E.S can be applied to study of agriculture and the design of sustainable production system

- 2. E.S also aims to protect Bio diversity
- 3. E.S is helpful in environmental management. It helps in formulating the broad social, economic, and regulatory frameworks in which environmental problems are resolved.
- 4. This discipline helps to educate people regarding their duties towards environmental protection.
- 5. It encourages the development of scientific principles and the application of these principles to solve environmental problems
- 6. E.S provides knowledge about the development and utilization of energy resources and the role of public policy therein.
- 7. E.S. examines the scientific basis for environmental and social concerns about our present energy needs, global climate change, toxic emissions, and waste disposal
- 8. E.S helps achieve sustainable development and understand the relationships between development and the environment.
- 9. E.S helps to maintain ecological balance by providing a basic operating knowledge of environmental systems and processes

- 10. It also gives information regarding the changes that take place due to anthropogenic factors and helps gain skills of analyzing various environmental systems and the effect of human activities on them
- 11. E.S. provides the skills necessary to obtain solutions to the environmental problems of our planet is facing today.
- 12. Gives information relating to population explosion, growth and development, impact of population growth on the resource consumption and national economy
- 13. Explains the coexistence of both living and non living organisms and their contribution to the nature for its sustenance
- 14. Gives information about water conservation, watershed management and importance of water as a universal solvent

SCOPE OF ENVIRONMENTAL STUDIES

(Career options)

Since Environmental studies are multidisciplinary in nature, it is considered to be a subject with vast scope. The study of the environment is no longer limited to issues of health and sanitation but is now concerned with pollution control, biodiversity conservation, waste management and conservation of depleting natural resources. These measures require expertise and hence are increasingly creating job opportunities. The opportunities in this field are immense not only for scientists but also for engineers, biologists, and environmental journalists. Environmental science can be applied in the following spheres.

Research and Development: various universities and governmental organizations offer avenues for such research. They conduct research studies in order to develop theories or methods of monitoring and controlling environmental pollution. Because of an increasing threat from global warming, various steps are being taken towards reduction of green house gases and adoption of renewable energy sources. There is great awareness now regarding the use of solar energy.

<u>Pollution control boards</u>: investing in pollution control technologies will reduce pollution. In India also the pollution control boards are seriously implementing pollution control laws and insisting on up grading of effluents to prescribed standards before they are discharged on land or into water body.

<u>Green marketing</u>: Due to green marketing there is a great demand for environmental auditors and environmental mangers. To ensuring the quality of products with ISO mark, now there is an increasing emphasis on marketing goods that are environment friendly (eco-friendly). Such products have ecomark or ISO certification. (Organization of environmental management system)

<u>Industry:</u> Environmental scientists work towards maintaining ecological balance, conservation of bio diversity, and preservation of natural resources. Most industries have a separate environmental

research and developmental section which governs the impact that their industry has on the environment. Rapid industrialization is increasingly degrading the environment. To combat this menace, there is a growing trend towards manufacture of green goods and products

<u>Social Development</u>: nongovernmental organizations NGO's help in creating awareness regarding the protection of environment. They also work towards disseminating information and bringing about changes in political policies that adversely affect the environment. They also are organizing awareness camps.

<u>Environmental journalism</u>: Environmental journalism is an emerging field which helps in bringing environmental problems to public notice.

Environmental management: there are several independent environmental consultants working with the central and state pollution control boards.

<u>Natural and resource conservation</u>: natural assets such as forests contribute towards maintain a balance in the environment. Therefore, managing and maintenance of forest and wild life is an important task under natural resource conservation.

<u>Green advocacy</u>: there is need for environmental lawyers. With the increasing of environmental problems and other emphasis on implementing various acts and laws related to environment. The environmental lawyer should be able to plead the cases related to water, air pollution, forest and industrial effluents, wild life.

STOCKHOLM AND RIO SUMMIT

The advancement of human civilization from a hunter gatherer society to the modern technologically advanced industrial society has induced man to tamper with the natural environment for creating an economic, social and cultural environment of his choice. This has resulted in the depletion of natural resources and led to water, air and soil pollution. Technological development has generated noise pollution. To protect ourselves, plants, animals and the environment, several laws have been enacted at the national and international levels.

The United Nations Conference on Human Environment, 1972 at Stockholm was attended by the representatives of 113 world governments to discuss this issue. At the conference it was proclaimed that, 'the protection and improvement of human environment is a major issue which affects the well being of people and the economic development throughout the world and

it is the duty of all the governments and its people to exert common effort for the preservation and improvement of human environment, for the benefit of all the people and their posterity.'

India is the first country to impose a constitutional obligation on the state and citizens to protect and improve the envorinment as aprimary duty. Article 48A of the Indian constitution says: the state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country.

In the Rio Declaration (Earth Summit) 1992, in principle 15 of Agenda 21, the precautionary approach was codified for the first time at the global level to protect the environment. It states that:

- 1. Every state should apply the principle according to their capabilities.
- 2. Where there are threats of serious damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.

The precautionary principle is now widely accepted as a fundamental concept of national environmental laws and regulations in management at the international, regional and domestic levels.

It is used across diverse areas such as pollution, toxic chemicals, food, fisheries management, species introduction, wildlife, trade and so on.

2. Describe various environmental institutions in India and people worked for the sake of environment.

A. Environmental Institutions in India

1. Bombay Natural History Society - BNHS

- Founded in 1883
- Major contribution on Wildlife research.
- Largest and oldest environmental NGO in the subcontinent engaged in the conservation of nature and natural resources, education and research in natural history, with members in 30 countries.
- ▶ Helped the Indian Government to frame wildlife related laws.
- Organized Save the Silent Valley Campaign
- Hornbill, Journal on Natural History are the publications

2. World Wide Fund for Nature - India WWF-I

- Founded in 1969
- ➤ WWF-India started as a wildlife conservation organization.
- > Started at Mumbai and now the head quarter is at New Delhi.
- > Branch offices are at all over India.

- > The main objective is to ensure the conservation of the country's wildlife and wild habitats, wildlife education and awareness.
- ➤ Nature clubs for School Children
- > Think tank lobby force for environmental and developmental issues

3. Centre for Science and Environment (CSE)

- Founded in 1980
- Organizing campaigns, holding workshops and conferences and producing environment related publications.
- ➤ State of India's Environment Citizen's report on Environment
- ➤ Down to Earth fortnightly magazine on Science and Environment
- *→ Gober times Environment for beginners*
- ➤ Books, Posters, Video films

4. CPR – Environmental Education Centre (CPR-EEC)

- Established in 1988
- > To conduct verities of programs to spread environmental awareness and create an interest in conservation among the general public.
- Focus is on NGO's, teachers, women, youth and children
- > To conserve nature and natural resources.
- Programs on wildlife and biodiversity issues.
- Publishes large no. of books.

5. Salim Ali Centre for Ornithology and Natural History (SACON)

- Founded in 1990
- An autonomous organization is a national centre for studies in Ornithology and Natural History.
- ➤ The centre was named befittingly after Dr. Sálim Ali in appreciation of his life-long services to India's bird life and conservation of natural resources.
- SACON was dedicated to the nation on February 11, 2000 by the Honourable Minister for Environment and Forests, Government of India, Mr. T.R. Baalu.

6. Madras Crocodile Bank Trust (MCBT)

- Established in 1976
- ➤ The first Crocodile Conservation Breeding Centre in Asia.
- Conservation and propagation of Endangered reptiles.
- ➤ Over 1500 Crocodiles and Hundreds of Eggs were supplied to Forest Dept.
- > Started first Sea Turtle survey in Asia
- ➤ Environmental Education programmes villagers, Schools, Resource persons
- ➤ In 1992 Andaman & Nicobar Environmental Team (ANET) started for surveys
- ➤ Irula Snake Catchers Corporation Society A adivasi self help group Supplies Snake and Scorpion venom for preparing antivenom

> Started Irula Tribal Women's Welfare Society

PEOPLE IN ENVIRONMENT

1. Rachel Carson

- ▶ Effect of pesticides on Nature and Man kind
- ▶ Book **Silent Spring** led to change in Government Policies towards environmental conservation.

2. Dr.Salim Ali - Ornithologist

- ▶ Father of Indian Ornithology
- ▶ Bird man of India, Worked in BNHS
- ▶ Wrote several books on Birds Indian Birds and Fall of Sparrow
- ▶ He was ous country.s leading conservation scientist and influenced environmental policies on our country for over 50 years.

3. Dr. M. S. Swaminathan - Agricultural Scientist

- ▶ Father of Indian Green Revolution
- Worked on Conservation of Biodiversity
- ▶ Started MS Swaminathan Research Foundation in Chennai, which does work on the conservation of biological diversity

4. Madhav Gadgil - Ecologist in india

- ▶ He interests to Developing Community based Biodiversity Registers and
- Conserving Sacred Grooves
- ▶ Studies on Mammals, Birds & Insects
- ▶ Wrote 6 books and Editor for *Lifescapes of peninsular India*

5. M. C. Mehta - Environmental Lawyer

- Filed several public interest litigations for supporting the cause of environmental conservation.
- ▶ Protecting the TajMahal & Cleaning the River Ganga
- ▶ Banning intensive shrimp farming in coastal areas
- ▶ Initiating government to environmental education in schools & Colleges

6. Anil Agarwal - Journalist

- ▶ Founder of CSE, Wrote a book on State of India's Environment -1982
- ▶ He founded the CES, an active NGO that supports various environmental issues.

7. Medha Patkar- one of rural India's champions.

▶ Leader of Narmada Bachavo Andolan, Fought against construction of DAMs on Narmada River to protect the tribal communities

8. Sunderlal Bahuguna

- Founder and leader of Chipko Movement
- ▶ Chipko movement has become an internationally well known example of a highly successful conservation action program through the efforts of local people for guarding their forest resources.
- Fought to prevent the construction of TEHRI DAM

9. Wangari Maathai

Wangari Maathai founded the Green Belt movement in Kenya in 1977, which has planted more than 10 million trees to prevent soil erosion and provide firewood for cooking fires. She is the first woman in central or eastern Africa to hold a Ph.D., first woman head of a university department in Kenya, first African woman to win the Nobel Prize in Peace during 2004.

<u>10.Indira Gandhi</u> as PM played a very significant role in the preservation of India's wild life. It was during her period as PM, that the network of protected areas grew from 65 to 2981. The wild life protection act was formulated during the period when she was PM and Indian Board for wild life was excremely active as she personally chaired all its meetings.

NOTE:

Important Environmental Days

- ➤ World Wetlands Day Feb, 2nd
- ➤ World Forest Day March, 21
- ➤ World Water Day March, 22
- World Health Day- April, 7
- Earth Day April, 22
- ➤ World Biodiversity Day May 22
- World Environment Day June 5
- World Population Day July 11
- International Day for the Preservation of the Ozone Layer September 16
- ➤ Green Consumer Day- September 28
- ➤ Wildlife week-October1-7
- World Food Day-October 16
- World planting day October 22
- World Aids Day- December 1

4. Describe some of the important environmental movements in India

A. Environmental Movements:

1. Chipko movement: The forests of India are a critical resource for the subsistence of rural peoples throughout the country, but especially in hill and mountain areas, both because of their direct provision of food, fuel and fodder and because of their role in stabilising soil and water resources. As these forests have been increasingly felled for commerce and industry, Indian villagers have sought to protect their livelihoods through the Gandhian method of satyagraha non-violent resistence. In the 1970s and 1980s this resistance to the destruction of forests spread throughout India and became organised and known as the Chipko Movement.

The first Chipko action took place spontaneously in April 1973 and over the next five years spread to many districts of the Himalaya in Uttar Pradesh. The name of the movement comes from a word meaning 'embrace': the villagers hug the trees, saving them by interposing their bodies between them and the contractors' axes. The Chipko protests in Uttar Pradesh achieved a major victory in 1980 with a 15-year ban on green felling in the Himalayan forests of that state by order of India's then Prime Minister, Indira Gandhi. Since then the movement has spread to Himachal Pradesh in the North, Kamataka in the South, Rajasthan in the West, Bihar in the East and to the Vindhyas in Central India. In addition to the 15-year ban in Uttar Pradesh, the movement has stopped clear felling in the Western Ghats and the Vindhyas and generated pressure for a natural resource policy which is more sensitive to people's needs and ecological requirements.

The Chipko Movement is the result of hundreds of decentralised and locally autonomous initiatives. Its leaders and activists are primarily village women, acting to save their means of subsistence and their communities. Men are involved too, however, and some of these have given wider leadership to the movement. Prominent Chipko figures include: Sunderlal Bahuguna, a Gandhian activist and philosopher, whose appeal to Mrs. Gandhi results in the green-felling ban and whose 5,000 kilometre trans-Himalaya footmarch in 1981-83 was crucial in spreading the Chipko message. Bahuguna coined the Chipko slogan: 'ecology is permanent economy'.

2. Tehri Bachavo Andolan: The Tehri Dam in the outer Himalayas in Uttar Pradesh, when completed, will submerge Tehri town and nearly 100 villages. Ever since the dam was sanctioned in 1972, local people have been opposing the dam and resisting its construction. Scientists, environmentalists and other groups have also opposed this dam.

Little has been done to ensure the proper rehabilitation and compensation for nearly a lakh of people who will be uprooted from their homes as a result of this dam, as no alternative land is available. There is also emotional and psychological trauma caused by forcibly removing people from their homeland where their families have lived for centuries.

Resettlement requires alternate land. However, in our overpopulated country, there is no arable high quality land easily available. Thus, most project-affected persons are usually given unusable wasteland. Rehabilitation involves more than just giving land. In most cases, even this basic aspect is not adequately done. The greatest battle to save their own precious land has been carried out by the tribal people of the Narmada River. They have fought to save their lands for decades. The Narmada Bachao Andolan movement has shown how bitter people can get over this issue.

3. Narmada Bachavo andolan: Narmada Bachao Andolan is the most powerful mass movement, started in 1985, against the construction of huge dam on the Narmada river. Narmada is the India's largest west flowing river, which supports a large variety of people with distinguished culture and tradition ranging from the indigenous (tribal) people inhabited in the jungles here to the large number of rural population. The proposed Sardar Sarovar Dam and Narmada Sagar will displace more than 250,000 people. The big fight is over the resettlement or the rehabilitation of these people. The two proposals are already under construction, supported by US\$550 million loan by the world bank. There are plans to build over 3000 big and small dams along the river.

Narmada Bachao Andolan It is a multi crore project that will generate a big revenue for the government. The Narmada Valley Development plan is the the most promised and most challenging plan in the history of India. The proponents are of the view that it will produce 1450 MW of electricity and pure drinking water to 40 million people covering thousand of villages and towns. Some of the dams have been already been completed such as Tawa and Bargi Dams. But the opponents says that this hydro project will devastate human lives and bio diversity by destroying thousand of acres of forests and agricultural land. On the other hand it will overall deprive thousands of people of their livelihood. They believe that the water and energy could be provided to the people through alternative technological means, that would be ecologically beneficial.

Led by one of the prominent leader Medha Patkar, it has now been turned into the International protest, gaining support from NGO'S all around the globe. Protestors are agitating the issue through the mass media, hunger strikes, massive marches, rallies and the through the on screen of several documentary films. Although they have been protesting peacefully, but they been harassed, arrested and beaten up by the police several times. The Narmada Bachao Andolan has been pressurizing the World Bank to withdraw its loan from the project through media.

The strong protests throughout the country not only made impact on the local people but has also influenced the several famous celebrities like film star Aamir Khan, who has made open efforts to support Narmada Bachao Andolan.

He said he only want that those who have been rendered homeless should be given a roof. He pleaded to the common people to take part in the moment and come up with the best possible solutions.

GLOBAL CLIMATE CHANGE AND GREEN HOUSE EFFECT OR GLOBAL WARMING

Weather is defined as the condition of the atmosphere at a particular place and time. It refers to the long term pattern of weather conditions of a given area. Change is a fundamental characteristic of the environment. Climate change refers to the variation in earth's global climate or in regional climates over time. These changes can be caused by earth's internal processes, by external forces such as variation in sunlight intensity, or by human activities.

Earlier, natural processes caused changes in earth's climate. But today human activities are beginning to affect the climatic conditions of the planet adversely and rapidly.

Human activities over a long period of time have resulted in a dangerous phenomenon called the green house effect. The term is used to indicate a heat trapping process caused by gases such as carbon dioxide, nitrogen oxides, methane, CFCs, and water vapour, which are transparent to incoming solar radiations but do not allow the infrared radiations emitted from the earth's surface to escape the atmosphere causing the heat to get trapped. The result of this phenomenon is a long term rise in the average temperature of earth as a whole, which is called global warming.

The natural trapping of heat or the greenhouse effect has make the earth habitable; without it, earth would have been a cold, lifeless planet. This effect helps to maintain the mean temperature at 15°C, while in the absence of the greenhouse effect, the mean temperature would have been around -18°c. thus greenhouse effect is blessing and not a curse; however this inference stands true only as long as the green house gases are present in the atmosphere at an optimal level. Increase in human activities tends to disrupt this optimal balance, leads to global warming.

(OR)

- 1. Short wave radiations from the sun penetrate the earth's atmosphere
- 2. Some solar radiation is reflected by the atmosphere and the earth's surface.
- 3. Remaining solar radiation reaches the earth's surface.

- 4. Solar energy is absorbed by the earth's surface and warms it and is converted into heat causing the emission of long wave (infrared) radiation back to the atmosphere.
- 5. Some of the infrared radiation is absorbed and reemitted by the green house gases. The direct effect is the warming of the earth's surface and the troposphere. The earth's surface gains more heat and infrared radiation is emitted again; by this process, some of the infrared radiation is trapped in the atmosphere by green house gases causing a warming of the earth's climate.
- 6. Some of the infrared radiation passes through the atmosphere and is lost in space.
- 7. To sum up, the green house effect is the rise in temperature that the earth experiences because certain gases in the atmosphere trap energy from the sun.

The content of carbon dioxide in the atmosphere directly depends on deforestation and burning of fossil fuels.

Other gases such as methane, chlorofluorocarbon and ozone released from industries, also play an important role in the green house effect.

Environmental effects of global warming:

- 1. <u>Rise in sea level</u>: global warming will lead to the expansion of sea water and to the melting of glaciers and polar ice caps. The rise in sea levels would submerge small islands and coastal states. Populated places like Bangladesh, Maldives, coastal cities of India etc.
- 2. <u>Agricultural production</u>: increased evaporation of water and drier soils would result in prolonged droughts. Soil moisture is reduced, leads to decrease the productivity. In the drier areas, the need for irrigation would increase. And suffer from increased pest attacks, crop diseases, and weeds. Increase in surface temperature by 1°C will adversely affect the world food production.
- 3. **Storms:** global warming may increase the frequency and intensity of cyclones such as hurricanes and violent storms.
- 4. <u>Weather extremes:</u> earth's mean surface temperature will rise. As a result, most places will become hotter. More heat waves are produced.
- 5. Loss of biodiversity and destruction of ecosystems
- 6. Adverse effects on human health

Control measures or remedial methods:

- 1. Reduction in the use of fossil fuels.
- 2. Shifting to the renewable energy sources that do not emit green house gases.
- 3. Increasing the use of energy efficient and cleaner production technologies and practices.
- 4. Reducing deforestation, adopting better forest management practices, and undertaking afforestation to reduce the amount of carbon in the biosphere.
- 5. Favour sustainable agriculture.
- 6. Remove methane emissions through waste management.

ACID RAINS

Acid rain is rain which is unusually acidic (pH<6) caused mainly by atmospheric pollution with sulphur and nitrogen compounds.

Acid rain was discovered in the 1800s in Great Britan.

Sulphuric acid H2SO4 and nitric acid HNO3 are the two main components of the acid rain. Acid rain is measured using pH scale.

$$S + O_2 \rightarrow SO_2$$

 $2SO_2 + O_2 \rightarrow 2SO_3$
 $2SO_3 + 2H_2O \rightarrow 2H_2SO_4$
 $N_2 + O_2 \rightarrow 2NO$
 $2NO + O_2 \rightarrow 2NO_2$
 $2NO_2 + O_2 \rightarrow 2NO_3$
 $NO_2 + NO_3 \rightarrow N_2O_5$
 $N_2O_5 + H_2O \rightarrow 2HNO_3$

These reaction indicate the mechanisms of the formation of nitric acid and sulphuric acid. These acids are mixed with rain water and fall down on earth as acid rain.

Sources of acid rain:

<u>Natural sources</u>: small percentages of pollutants are released from natural sources of SO2, while NOx are released from gaseous pollutants and particulates into the atmosphere. These combine to form wet deposition and dry deposition. These depositions affect plants and animals. These two depositions together are called acid rain.

Anthropogenic sources: about 90% of sulphur emissions and 95% nitrogen emissions are attributable to human activity. The emissions come from combustion of coal in electric power plants, oil refineries, natural gas wells and burning fuels at high temperatures. About 40% of this comes from

automobiles and trains and about 3% comes from industrial combustion processes and about 25% are from thermo-electric generating plants. Huge quantities of Sox and NOx are released in all these activities.

Effects:

- 1. Acid rain increases the acidity of the soil and there by leaches out all its nutrients and reduces agricultural productivity. Acid rain may change the characteristics of soil and eventually pollute the streams and lakes.
- 2. Acid rain also affects the aquatic ecosystem. It increases the acidity of lakes, ponds, and other water bodies and converts them as graveyards for fish and other aquatic life.
- 3. Acid rain causes extensive damage to buildings, marble sculptures, limestone, slate and mortar by form calcium carbonate. Acid rain also causes corrosion of metals, paints, textiles, and ceramic. TajMahal in Agra, the historical buildings and mountains suffered damage due to acid rain.
- 4. Acidification of the soil causes the acid deposits to enter the food chain. It leads to serious nervous, respiratory, and digestive disorders in humans. Excessive acid rain will affect the nervous, respiratory and digestive systems of human –beings making a person a neurological patient.

Remedial measure against acid rain:

The only remedial measure to control acid rains is to control the emission of the oxides of sulphur and nitrogen from industries and power plants by using proper control equipment and stringent control norms. Periodic application of lime to neutralize acidity is another solution, but it is expensive and cannot be applied on a large scale.

OZONE LAYER

Ozone is an odourless, colourless gas composed of three oxygen atoms. Ozone is naturally formed by short wavelength, ultraviolet radiation in the upper stratosphere. Wavelength less than 240nm are absorbed by normal oxygen molecules, which dissociate to give two O atoms.

$$O_2 \xrightarrow{hv} O + O^*$$
$$O + O_2 \longrightarrow O_3$$

$$O_3 \xrightarrow{hv} O + O_2$$

This ozone layer absorbs 97-99% of the sun's high frequency uv light, which is potentially damaging to life on earth. It is located in the lower portion of the stratosphere, from approximately 13 km to 20km above earth.

Ground level ozone is harmful to the human respiratory system and acts an as eye irritant. However, ozone is used commercially to kill microorganisms during water purification process and as a bleaching agent. If present in the stratosphere, ozone acts as a protective layer shielding the earth from harmful UV radiation, where as in the troposphere, ozone acts as a harmful pollutant and is the major component of photochemical smog. More than a trace of this gas in the troposphere can damage human lungs and tissues, and also harm plants. Ozone is also a green house gas and contributes to the greenhouse gas.

Causing and mechanism of depletion of ozone layer:

The main cause of ozone depletion was found to be the widespread use of chlorofluorocarbons (CFCs). They are used as coolants in the refrigerators and air conditioners. They are also used to clean electronic circuit boards used in computers, phones, etc. And in the manufacture of foams for mattresses and cushions, disposable Styrofoam cups, packaging material, cold storage, etc.

$$\begin{aligned} &Cl + O_3 \rightarrow ClO + O_2 \\ &ClO + O_3 \rightarrow Cl + 2O_2 \end{aligned}$$

$$O_3 + O \longrightarrow 2O_2$$

Environmental effects of Ozone layer depletion:

The umbrella of ozone layer absorbs harmful UV radiation before it reaches the ground. Ozone depletion in the stratosphere results in more UV radiation reaching the earth's surface. Increase in incidence of UV radiation on earth's surface can be related to adverse effects on human health.

- 1. <u>Effect on terrestrial plants</u>: increased UV radiation affects plants by reducing leaf size and increasing germination time. This could decrease crop yield of corn, rice, soybeans, peas, and wheat. It also leads to loss of chlorophyll in leaves, and thus reduction of photosynthesis. Loss of agricultural productivity.
- 2. <u>Effect on aquatic community</u>: UV radiation can penetrate 10 to 20 m deep in water. The radiation kills many planktonic organisms. Death of phytoplankton adversely affects the aquatic food chain.
- 3. **Effect on human beings**: ozone depletion may increase the rate of skin cancer, skin burns and cause the skin to freckle and age faster. It increases the frequency of cataracts and other eye diseases in human and animals. The ability of immune system is also weakened.

- 4. **Effect on climate**: ozone depletion will disturb the temperature gradient.
- 5. <u>Effect on materials</u>: Increase in UV radiation damages paints and fabrics, causing them to fade faster. Plastic furniture, pipes, etc., also deteriorate faster when exposed to the sun.

POPULATION EXPLOSION AND POPULATION GROWTH

The population of the world which was 2.5 billion in 1950 has increased to 6.7 billion by 2008 and is expected to increase further to about 8 billion by 2020. The rapid growth in human population is exerting tremendous pressure on the available resources of the planet causing a global environmental crisis. The natural ecosystems of the world are slowly being altered by human beings according to their needs and are being converted to man-made ecosystems.

The population growth in South Asia has been tremendous between 1901 and 1991.

The study of the trends in human population is called demography. Three main factors decide the increase or decrease in populations. They are birth rate, death rate, and migration.

Population explosion is a sudden spur in the rate of population growth.

According to theory of demographic transition, every country passes through three stages of demographic transition.

In the first stage, both birth and death rates are high, and hence population remains more or less stable.

The main features of this stage are backward economy where agriculture is the main occupation, low per capita income, low standard of living, inadequate and unbalanced diet, absence of educational opportunities, and presence of social evils like polygamy, early marriages etc.

In the second stage, there is rapid growth of population takes place.

Causes of population growth:

1. <u>Conquest of diseases</u>: population has shown a remarkable increase during the past few decades because of the improvement in medical facilities and cure of dreaded diseases. A great amount of knowledge has been gained regarding ways to prevent and cure several life threatening diseases. Therefore, the diseases that would have killed millions of people about a century ago, do not affect many people now. Thus, more and more people are reaching old age these days. Improved knowledge about nutrition, vaccinations, better public health

- practices, and the development of new medicines have led to a much lower death rate than ever before and this rate is decreasing further each year.
- 2. <u>Improvement in public sanitation</u>: an increasing number of people can now meet the basic needs such as food, water, and housing. Many epidemic diseases such as cholera, typhoid, dysentery, etc., are related to unclean drinking water. Before 1990, less than 50% of the population had access to safe drinking water. By 1990, the access to safe drinking water increased to almost 75%
- 3. **Poverty:** people who live below the poverty line wrongly believe that more children mean additional hand to work; to help in the fields, to work for wages or to beg on the streets, to fetch water and fuel wood, to look after younger siblings while the parents work, and to look after the parents in their old age. They are unable to adequately feed their children or provide them with proper education. So they remained as illiterate and unskilled and poor throughout their lives like parents. Moreover, illiterate people are ignorant of the family planning measures available and hence are the major contributors to the growth in population.
- 4. **Preference for sons:** one of the most disturbing trends in India is the preference for sons; this attitude is found in all strata of the society and is not restricted to poor and uneducated people. In many families, the desire for a son, and often more than one son, results in having several children.
- 5. <u>Early marriages</u>: child marriage, which involves marrying off young children even before they have attained a marriageable age. People who are married at an early age have more children because they start having children early.
- 6. <u>Illiteracy</u>: illiteracy is another factor responsible for high birth rate. Illiterate people have no access to information related to family planning and hence are largely responsible for growth in population. So women education is very important. Educated women have fewer children and also able to give they better nutrition and health care. Therefore, spreading awareness and educating women may help in controlling the high birth rate.

EFFECT OF POPULATION GROWTH:

Increase in population causes socio economic problems. Some of them are,

- Excessive growth in population leads to more deforestation activities in order to meet the
 requirements of fuel wood, agriculture, settlements, and also for industrial establishments.
 The indiscriminate felling of trees for agricultural expansion and timber products also leads to
 the degradation of watersheds affecting the water catchment areas.
- 2. Population growth affects the natural resource availability.
- It causes increased demand for food, water, land, and other essential materials, such as fire wood.

- 4. Excessive exploitation of natural resources causes ecological imbalance in nature.
- 5. An increase in the number of people, with majority living in poverty, puts tremendous pressure on social, health and educational services.
- 6. Unemployment is another serious problem arising because of over population.
- 7. Owing to the growing population, water resources are exploited for various purposes including domestic, livestock, and industrial use. Further, a large population leads to extensive economic activities and rising pollution in rivers, lakes and ponds.

POPULATION AMONG VARIOUS NATIONS:

Improved medicine, sanitation and nutrition have produced a major decline in death rate. The rates of population growth are dependent on climate conditions and reproductive potential of the countries and may vary among countries and also between different regions of the same country.

The population of china in 2002 was 1,285 million, while that in Naru (located at South Pacific) was only 11,845.

The difference in population growth can be seen from the fact that Asia accounts for over 70% of the global population with approximately 3.8 billion people, of which China comprises 20%, India 16%, Africa 12%, Europe 11%, North America 8%, South America 5.3%

Developed Countries such as Australia, New Zealand, Japan, Europe and North America, contain 1.19 billion people, while the population of developing regions is estimated at 4.6billion and is growing at a rate of 1.6% annually. Over next 30 years, almost 98% of the global population growth is takes place in developing countries.

The variations are seen in the population distribution is due differences between developed and developing countries.

Developed countries such as Australia, Canada, New Zealand and United States have the highest population growth rates; this may be due to the effect of immigration of people from developing countries.

Countries such as Hungary, Italy, Latvia, Portugal, the Russian Federation, and Spain have recorded a population growth of nearly zero, while a number of Eastern European Countries are reflecting negative population due to dismal health and medical facilities and rising death rates, various epidemics, natural disasters, and other factors, as well as emigration.

India presents a mixed picture, where high growth rates in the north of the country and low rates in the south.

Efforts to improve the status of women, including better reproductive health care and education are gaining momentum in the entire south region.

ENVIRONMENT AND HUMAN HEALTH---SUSTAINABLE DEVELOPMENT

According to WHO, health is defined as a set of complete physical, mental, and social well being and not merely the absence of disease. Basically health is a quality of life and it is difficult to define or measure the magnitude of health.

Due to industrialization, the environment is continuously being contaminated by various pollutants. Human health is intimately connected to the surrounding environment: everyday, we breathe in polluted air, ingest contaminated food and water, and experience stressful noise levels. All kinds of the pollutions lead to serious health disorders and hence affect the well being of individuals. Biological, social, and physical environment keeps on changing throughout the life of the individual. Therefore, for good health a process of continuous adaptation is required.

Environmental influences: large scale environmental changes may cause a variety of diseases. Many health problems today reflect population pressure, climate change, and environmental pollution. Disruption and destruction of the world's natural life support system constitute the greatest threats to human health. The majority of poor people in the rural areas of India is affected by the indoor air pollution in the form of smoke and fume from the burning of biomass, such as wood, agricultural residues and animal dung, which is used chiefly for cooking food. The environmental factors, such as water, soil, air, etc. play a major role in spreading of various deadly diseases. Cholera, dysentery, gastroenteritis, etc., are some of the water and sanitation related illness. Poor people live in unhygienic conditions are most susceptible to diseases caused by environmental factors, and the most affected are the children

Behavioral influences: many of the diseases prevalent today are a result of the modern lifestyle of the people. Alcoholism, smoking, chewing tobacco, irregular food habits, eating junk food, etc., result in various kinds of ill health.Less physical activity and too much of sitting leads to hypertension and obesity.

<u>Genetic influences</u>: many deadly and life threatening diseases are inherited from parents. All living organisms inherit a set of genes from their parents that determine their physical and physiological characteristics. Sometimes, certain genetic defects may lead to children being born with abnormalities. Hemophilia, sickle cell anemia, etc are some genetically induces diseases.

Resource depletion, waste generation, disturbance of ecosystem, consumerism, discharge of air or water pollutants, etc., are some of the human activities which have continuously been changing our environment. As a result of this, human health has been adversely affected. The following facts are indicators which support that health is an outcome of the interactions of human with their environment.

- 1. Due to exposure to the air pollutants released by industries, motor vehicles, smoking, etc., humans suffer from serious respiratory diseases such as tuberculosis and lung cancer.
- 2. Due to consumption of impure water, cholera, typhoid, diarrhea, dysentery, etc., are caused
- 3. Due to contamination of water through harmful pesticides, cancer, infertility and neurological diseases are caused.
- 4. Due to scarcity of water and consequent unhygienic conditions, tuberculosis, tetanus and leprosy are caused.
- 5. Due to stagnant water, mosquitoes breed and spread malaria.
- 6. Due to high rise buildings, visual pollution and mental strain is caused.
- 7. Due to untreated human excreta, several kinds of virus and bacteria grow which give rise to diseases like cholera, typhoid, jaundice, diarrhea, etc.
- 8. By direct contact with blood of infected persons or by exchange of body fluids during sexual contact, AIDS is caused.
- 9. By consuming arsenic contaminated water for more than 5 years, humans develop colour change on the skin, cancer of skin, bladder, kidney, lungs and legs.
- 10. Deforestation has resulted in biodiversity loss and depleted flora and fauna. Thus the sources of large number of medicines which are essential for maintaining human health are badly affected.

We must work for a sustainable environment, which ultimately will result in good health for all. A sustainable environment and good health is achieved through,

- 1. Avoiding consumerism
- 2. Anti smoking movements and campaigns,
- 3. Population control
- 4. Using public transport, controlling transport emissions

- 5. Afforestation and reforestation
- 6. Preventing industrial pollution, preferred us of renewable nonconventional energy instead of thermal power generation, and
- 7. Reduction in the consumption of natural resources, protection and conservation of natural resources.

ROLE OF INFORMATION TECHNOLOGY IN ENVIRONMENT AND HUMAN HEALTH

The computer is one of the most remarkable developments in the history of mankind. Technological development in information technology has connected people in different parts of the world into a single network. IT has tremendous potential in every walk of life such as business, economics, politics, medicines, environment, or culture. Development of internet facilities, World Wide Web, geographical information system (GIS), global positioning system (GPS), and information through satellites has generated a wealth of information on various aspects of day to day life.

IT AND ENVIRONMENT:

Information technology has enabled environmentalists to gather information and forecast disasters faster and more efficiently. Through GIS and GPS, a large amount of information and photographs are easily accessible, which help in environmental monitoring and impact assessment.

Remote sensing and GIS provide information regarding various environmental aspects such as floods, deforestation, desertification, ozone layer depletion, river and canal network, mineral and energy reserves, etc.

These systems are also useful in assessing the quality of soil, amount of air pollution, characteristics of water resources, effects of population and mis-management of solid wastes, etc., of any area in the world, and hence help in devising ways of improving the living condition of the area.

Gather information about different forms of pollution, the nature of the pollutants and their places of origin.

IT can also play an important role in predicting and warning about disasters and may also be used for identifying the affected areas so that help can be sent to these areas.

It warns of indiscriminate use of natural resources and of the hazardous results of excessive use of pesticides and germicides.

It provides information regarding the animal and plant resources of an area.

It also provides information about the effective control of population growth.

It helps in assessing damage to soil erosion and conservation.

It is also extremely useful in the field of education.

IT AND HUMAN HEALTH:

Information technology is now playing an important role in making health information accessible to more and more people.

It is helping in the effective management of medical information between health care providers and consumers.

Bioinformatics is the branch of science which involves the use of technology to solve biological problems and uses computational methods to mine vast amounts of data for critical knowledge and discoveries.

Information technology is a powerful tool with which activities related to the protection of health can be improved.

This technology provides different avenues for the improvement of various medical facilities in a hospital and can be used to form a single network of all hospitals in the country to ensure easy accessibility of medical facilities and information to people located even in remote corners of the country.

It is now possible to consult specialists located anywhere in the world at any time of the day in order to obtain knowledge regarding the recent developments in various fields of specializations.

IT is also transforming the way health care is delivered. Innovations such as computer based patient records, hospital information systems, computer based decision support tools, and community health information networks, telemedicine, and new ways of distributing health information to consumers are ensuring lower costs, better quality and improved accessibility of health care.

Development of information technology in the fields of medicine and health care will be of great help to human beings.

ECOSYSTEM

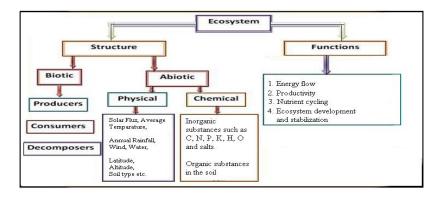
♣ A self regulating group of biotic communities of a species interacting with one another and

with their non living environment exchanging energy and matter.

- ♣ The term ecosystem is coined by British ecologist A.G.Tansley in 1935.
- ♣ According to him, the ecosystem means "the system resulting from the integration of all the living and non-living factors of the environment."
- ♣ Ecosystem is a natural unit that consists of living and nonliving parts which interacts to form a stable system

STRUCTURE OF ECOSYSTEM

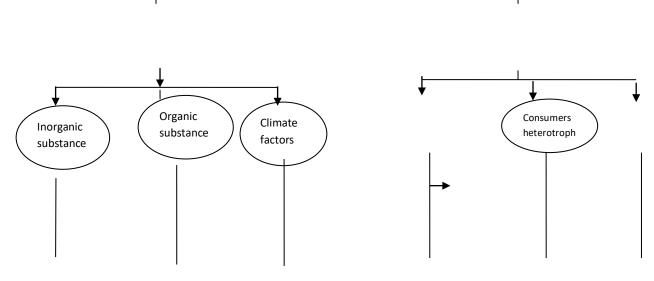
- 1. The composition of **biological** community including species (plants, animals and microbes), numbers, biomass, life cycles and distribution in space.
- 2. The quantity, distribution and cycling of the **non-living materials** such as a major and micro nutrients, trace elements and water.
- 3. The range or gradient of **conditions of existance** like temperature, light, RF, relative humidity, wind and topography.
 - There are two types of parts in the structure of ecosystem, called
 - Biotic parts
 - Abiotic parts.
 - ➤ The biotic part contains producers, consumers and decomposers
 - abiotic part is two of two types
 - physical parts
 - o chemical parts
 - Physical part contains solar flux, Average temperature, Annual rainfall, wind, water, latitude, altitude, soil type etc.
 - ➤ Chemical part contains chemical substances like C, H, N, P, K, O, organic substances in the soil and salts.



Bio sphere
All the ecosystem of the world

ecosystem

Page 25 of 44



In an ecosystem the biological cycling of materials is maintained by three groups Producers, Consumers, Decomposers / Recyclers

Producers: Autotrophic organisms, largely green plants which are able to manufacture the required food material from simple inorganic substances.

Consumers: Heterotrophic organisms, chiefly animals, which ingest other organisms or particulate organic matter, are included in this category

- i. Primary Consumers Herbivores: The animals that feed directly on living plants or plant residues. Producers can make their food themselves (Autotrophic organisms) like green plants. Green plants can make their food from simple inorganic materials. They have vegetarian diet.
 - eg: Deer, Blackbuck, Zebra, Elephant, Goat, Cow, Rabbit, Grasshopper, Caterpillar etc
- ii. Secondary Consumers Carnivores: The animals that feed on primary consumers. They are also called "Predators". These have non-vegetarian diet. Eg. Frog, Lizard, Wild dogs, Small fishes etc.
- iii. **Tertiary Consumers:** The animals that feed on Secondary consumers. They are also called "*Predators*". These have non-vegetarian diet. Eg. Snakes, Hawk, eagles, Tiger, Panther, etc.
- iv. **Omnivores:** Consumers, which feed on producers as well as on primary consumers, i.e. they have vegetarian as well as non- vegetarian diet. Eg: Insectivorous Birds, Sloth bear.

Decomposers or Recyclers or Micro-consumers or Saprotrophs or Detritivores

They feed on organic compounds of dead or living protoplasm of plants and animals for their food and energy. They absorb some of the decomposition or breakdown products & release inorganic compounds (nutrients) in the ecosystem, making them available again to producers. Eg: Bacteria, fungi, flagellates & actinomycetes.

FUNCTIONING OF ECOSYSTEM

- ♣ It regulates flow rates of biological energy. i.e., it controls the rate of production and respiration of the community.
- ♣ It regulates flow rates of nutrients. i.e., it controls the production and consumption of minerals and materials. Rate of materials or nutrients cycles
- ♣ Biological or ecological regulation which includes regulation of organisms by environment and regulation of environment by the organism.
- ♣ Several types of biochemical processes takes place in an ecosystem. The functions of ecosystem can be studies in following forms

The important functions of an ecosystem are

- Productivity
- Energy flow
- Nutrient cycling
- o Ecosystem development and stabilization

Productivity:

- o Productivity is the rate of biomass production.
- The productivity of an ecosystem is of two types
 - Primary productivity
 - Secondary productivity

o **Primary productivity**:

- > It is the rate at which released energy is absorbed by the green plants for making biomass through photosynthesis.
- ➤ It is expressed as g m⁻² year⁻¹ for dry matter and Kcal m⁻² year⁻¹ for energy.
- Primary productivity is of two types
 - Gross primary productivity
 - Net primary productivity

Gross primary productivity:

❖ It is the rate of total production of biomass by the green plants per unit area and

time.

➤ Net primary productivity:

- ❖ It the rate at which biomass stored by the producers after breathing and maintenance.
- ➤ Net primary productivity=Gross primary productivity—loss due to breathing and maintenance

Secondary productivity:

It is the rate of increase in the biomass of animals per unit area and time.

Energy flow:

- The functioning of ecosystem depends on the flow of energy through matter.
- Energy enters the ecosystem from the solar radiations and is changed into chemical form by the producers.
- o From there the energy passes from one tropic level to the next through food.

Nutrient cycling:

- In each ecosystem, the nutrients required for the growth of living plants are stored in the soil.
- The nutrients required for plants are Nitrogen, phosphorous and calcium.
- Nutrients are released from the decomposers like microorganisms while they decompose dead animals and plants in the soil.
- It makes nutrients available for reuse of plants. This process is called nutrient cycling.

FOOD CHAIN

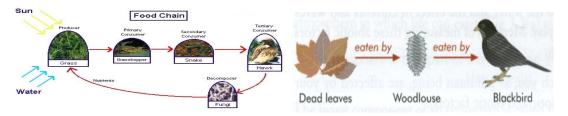
- ♣ The transfer of food energy from the producers, through a series of organisms (herbivores, carnivores and decomposers) with repeated eating and being eaten, is known as food chain.
- Each level of an organism in a food chain is called as Trophic Level.
- Food chain in an ecosystem start from green plants (produces)



Types of food chains

- **1. Grazing food chain**: This food chain starts from the living green plants and goes to grazing herbivores and onto carnivores.
 - **♣** Phytoplankton → Zooplankton → Fish → Large Fish

 - \downarrow Green plants \rightarrow goat \rightarrow wolf \rightarrow lion
 - ♣ Producers form the first link in a grazing food chain. They depend directly on solar radiation.
 - ♣ Primary consumers (herbivores) form the second link as they obtain their energy from the producers
 - ♣ Secondary consumers (carnivores) form the third link as they obtain their energy from the herbivores.



2.Detritus food chain:

This food chain starts from dead organic matter and goes to saprophytes or decomposers and eaten by primary, secondary and tertiary consumers.

Dead Organic matter \rightarrow Earth worm \rightarrow Frog \rightarrow Snake \rightarrow Hawk

Dead plants \rightarrow soil mites \rightarrow insects \rightarrow lizards

 $Dead\ organic\ matter
ightarrow\ bacteria
ightarrow\ protozoa
ightarrow rotifers$

The organic wastes and dead matter derived from grazing food chain are termed as **detritus**.

Grazing food chain and detritus food chains are linked with each other since dead organisms from grazing food chain form the base for the detritus food chain, which in turn, provides nutrients to the soil (green plants). Thus one cannot exist without the other.

- ♣ Solar energy → producers(plants) → primary consumers (herbivores) → secondary consumers(carnivores) → tertiary consumers(top carnivores) → detritivores
- \downarrow first topic level \rightarrow second tropic level \rightarrow third tropic level \rightarrow fourth tropic level

Significance of food chain

- ♣ Important for maintain and regulating the population size of different animals and thus are instrumental in maintenance of ecological balance.
- Food chains show a unique property of accumulation of certain chemicals. There are several pesticides, heavy metals, and other chemicals which are non biodegradable in nature and are not decomposed by microorganisms. They keep passing from one tropic level to other and increasing in their concentration, called bio magnification.
- ♣ By studying a food chain, we can understand how balance is maintained in an ecosystem.

- ♣ The study of food chain and webs is critical for understanding the route by which pollutants gets bio accumulated up the food chain.
- ♣ This is known as food web.
- For example:
- ♣ In grazing food chain
- ♣ In the absence of rabbit, grass may also be eaten by mouse.
- ♣ The mouse may be eaten by hawk directly or
- ♣ In other way, the mouse may be eaten by snake first; the snake is then eaten by hawk.
 - In grazing food chain
 - In the absence of deer, the rabbit is eaten directly by lion.

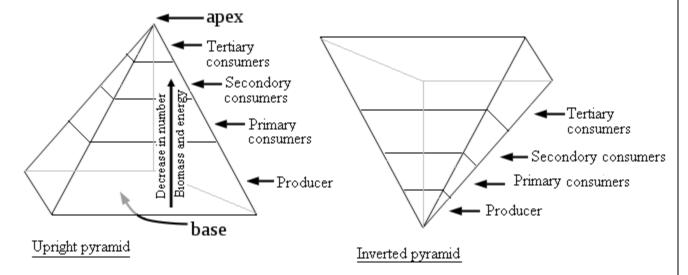
FOOD WEB

- Food chains do not work as a separate parts in natural conditions
- ➤ But these are connected to each other (inter connected)
- > This type of connections leads to the joining of many food chains into one other (interlocking pattern).
- Food Web: complex network of interconnected food chains called food web Food chains in natural conditions never operate as isolated sequences, but are interconnected with each other forming a sort of inter locking pattern, which is referred to as food web. i.e. the interlocking pattern of various food chains in an ecosystem
- > The linear arrangement of food chains hardly occurs and they are interconnected under natural conditions, thus there are found alternatives in nature.



ECOLOGICAL PYRAMIDS

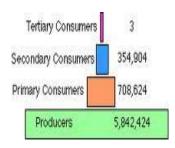
ECOLOGICAL PYRAMIDS



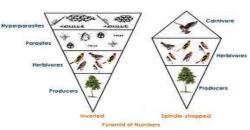
- ♣ It is a graphic representation of an ecological parameter like number, weight (or biomass), or energy present in different tropic levels of a food chain.
- ♣ Producer is placed at the bottom (base) of pyramid and consumers are placed at the top (apex) of pyramid.
- ♣ Ecological pyramids are of 3 types:
 - Pyramid of Numbers
 - o Pyramid of Biomass
 - Pyramid of Energy
- ♣ The graphical representation of the trophic structure and trophic function of an eco system is referred to as "Ecological Pyramids".
- ♣ In this, producer level occupies the base and top consumers occupy the apex of the pyramid.
- \bot Ecological pyramids may be of 3 general types:

Pyramid of number

- ♣ Shows the number of organisms at each trophic level of the ecosystem.
- Gives the relationship between producers, herbivores and carnivores at successive tropic levels in terms of their numbers.
- The organisms which have the maximum population in the ecosystem form the base of the pyramid, while with the minimum population form the apex.
- **Ex:** grassland ecosystem, cropland ecosystem and forest ecosystem.

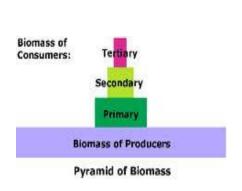


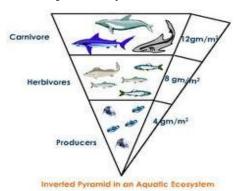




Pyramid of biomass

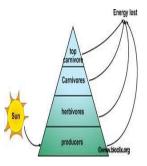
- **♣** Biomass is defined as the **total living material present in any organism.**
- It is measured in terms of dry weight of organisms per unit area.
- Gives the relationship between producers, herbivores and carnivores at successive tropic levels in terms of their weight.
- ♣ Ex: grassland and forest ecosystem and pond ecosystem

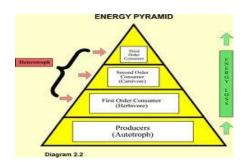




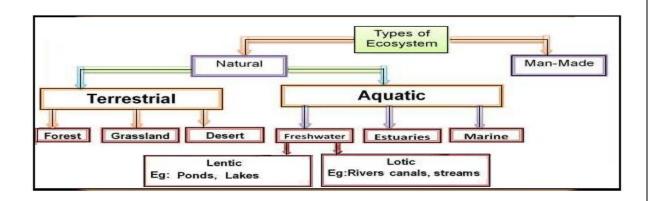
Pyramid of energy

- Gives the relationship between producers, herbivores and carnivores at successive tropic levels in terms of their energy
- ♣ Provides the best representation of the overall nature of an ecosystem. It shows the rates of passage of energy through the food chain, while the pyramid of number and biomass represent standing situations.
- → The energy transferred to the next trophic level is lesser. Therefore, the consumers get lesser amount of energy than herbivores. Since this energy relation is always maintained, the shape of energy pyramid always remains upright.
- The pyramids of numbers and biomass may be upright (or) inverted depending upon the nature of food chain in the particular ecosystem but the pyramids of energy are always upright.





Types of ecosystem or Classification of ecosystem



Ecosystems are classified on the basis of habitat.

1.Natural ecosystem: an ecosystem that is developed under natural conditions is called natural ecosystem. Natural ecosystems operate by themselves under natural conditions without interference by humans. Natural ecosystem can be terrestrial as well as aquatic. Habitats exhibit environmental conditions which determine the nature and characteristics of biotic communities.

Based on the kinds of habitat, ecosystems may be classified as

<u>a)Terrestrial ecosystem</u>: Ecosystems that are found on land are called terrestrial ecosystems. These are further subdivided in terms of physical conditions and their responses to biotic communities. Forest, grassland, desert, etc. are types of terrestrial ecosystem.

b)Aquatic ecosystem: ecosystems found in water are known as aquatic ecosystems. Ex: Tanks, oceans, rivers, lakes, etc., Aquatic ecosystems are further divided as

<u>i)Fresh water ecosystem</u>: only 3% of the world's water is fresh, 99% of this fresh water is either frozen in glaciers or is buried in aquifers. The remainder is found in lakes, ponds, rivers and streams and forms freshwater ecosystems.

Fresh water ecosystem may be classified into lotic or lentic on the basis of water movement and size.

In <u>lotic ecosystem</u> or flowing water ecosystem, water moves at a constant place in uniform direction.

In <u>lentic ecosystems</u>, or standing water ecosystems, the water remains in the same area for a longer duration.

<u>ii)Marine water ecosystem</u>: marine water covers two thirds of the surface of earth. The water of such ecosystem is saline in nature. Oceans, seas, tidal rivers, etc.

2.Artificial ecosystem: artificial ecosystems are maintained artificially by human beings. In this natural balance is disturbed regularly. In artificial ecosystems, humans try to control the biological and physiological properties of the ecosystem. Aquaria, gardens, dams, etc. are the examples. Croplands of maize, wheat, rice and so on are artificial ecosystems where ecology is disturbed regularly by various agricultural activities.

Explain various characteristic features, Biotic and Abiotic components, threats &Conservation of

- A. Forest ecosystem
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

FOREST ECOSYSTEM

- > In forest ecosystems, natural grass type plants are more than trees and other woody plants.
- Forests need annual rainfall of at least 50 cm.
- ➤ World forests are three types
- Coniferous forests
 - These forests contain trees having cone shaped top.
 - These forests grow in cold climates only.
- Tropical forests
 - These forests grow in hot climates.
- Temperate forests
 - These forests grow in both hot summer and cold winter.

Structure of forest ecosystem:

> Abiotic parts:

- o Inorganic and organic substances available in soil
- o Climate factors.eg: temperature, humidity, rainfall
- o Light play an important role in the development of forest community.

Biotic parts:

- The biotic components of a forest ecosystem consist of
- Producers: Different types of trees depending on the climate. The mixture of trees depends
 upon different forest types and conditions of the area.
- Consumers: The mixture of consumers in forest ecosystem depends upon the forest types and climate conditions.
 - ❖ The consumers consist of
 - i. **Primary consumers:** These are plant-eating animals (herbivores) like deer, elephant, mousses, etc.
 - ii. **Secondary consumers:** These are herbivore-eating animals (carnivores) like snakes, lizards, etc.
 - iii. **Tertiary consumers:** These are carnivore-eating animals like lion, tiger, etc.
 - iv. **Decomposers:** these are different types of bacteria and fungi. They decompose dead animals and plants to release nutrients into the soil.

Grassland Ecosystem

- > Grassland ecosystems are big open places filled with grasses.
- > Grasslands need annual rainfall of at least 50 cm to 90 cm.
- Grassland soils contain large amount of organic matter (humus) and it makes them productive (fertile).
- Grasslands are two types
 - Tropical grasslands:
 - Tropical grasslands are close to equator.
 - Tropical grasslands grow in hot climates.
 - Temperate grasslands:
 - These grow in both hot summers and cold winter.

Structure of grassland ecosystem:

Abiotic parts:

- The abiotic parts of grassland contain inorganic(C, H, O, N, P, S etc.,),
- Climate factors like temperature, rainfall, light and so on.

Biotic parts:

- The biotic components include
 - o **Producers**: main producer of grassland ecosystem is grass.
 - Primary consumers: These are grazing animals, insects, termites (insects that spoil wood) etc.
 - o **Secondary consumers**: These are snakes, lizards, jackal, fox, etc.
 - Tertiary consumers: These are hawks and big hawks (kites).
 - Decomposers: Different bacteria and fungi that live in grasslands are Penicillium,
 Rhizopus, etc.

Decomposition of grassland ecosystems:

- > The population of animals present in the grasslands has been affected by the decomposition grassland's natural environment (habitat).
- ➤ In grassland ecosystem, the population of Henslow's sparrows has decreased in number by 91%, while grasshopper sparrows have been decreased by 66% and dickcissels by 39% due to their decomposition.

DESERT ECOSYSTEM

- ➤ 6% of world's land surface is desert.
- In deserts, the annual rainfall is less than 25 cm.
- The area of world's desert is increasing every year.
- ➤ There are three types of deserts
 - Hot Desert
 - o Temperate Desert,
 - o Cold Desert.

STRUCTURE:

> Abiotic parts:

o Low rainfall, high temperature and sandy soil.

Biotic parts:

o The biotic parts of a desert ecosystem contain

Producers:

- Thorny (small sharp projections) bushes, cactus (a fleshy plant with thorns) are present in deserts.
- ❖ The plants are adjustable to live in dry conditions. For example: xerophytes.

Consumers:

- ❖ The consumers in a desert ecosystem contain different insects, lizards, reptiles (cold blooded animals) like snakes; rate type animals like rat, mice and squirrel etc (nocturnal rodents); birds like owl, bat etc.
- Camel is also known as the "Ship of Desert". It eats newly grown leaves (tender shoot) of plants.

Decomposers:

- ❖ Different bacteria and fungi that can live at high temperature (thermophilic) are present in desert soil.
- ❖ The decomposition process in desert area is slow due to non-availability of water.

Effects of humans on desert ecosystem:

- > The conditions of desert ecosystem cannot bring back to original position once they affected by humans due to hot sun, strong winds, low soil productivity and minimum rainfall.
- > The human effects like off-road tours lead to close packing of soil and it makes the land affected by wind and water very easily.
- ➤ Digging of underground pipelines for carrying gas, oil and water makes the soil easily affected by wind and water and it leads to wear away of soil slowly (soil erosion).

Aquatic ecosystem

- An ecosystem present inside a water body is called an aquatic ecosystem.
- There are two main types of aquatic ecosystem
 - o Marine water ecosystem
 - Fresh water ecosystem

a. Pond Ecosystem:

- A water body having little depth is called pond.
- ➤ Pond is an example of small, enough and self-controlling freshwater ecosystem.
- ➤ In pond ecosystem very less number of aquatic animals are present.
- Ponds are two types
 - Temporary ponds
 - Artificial ponds

Structure of pond ecosystem:

> Abiotic parts:

- Dissolved organic and inorganic materials like nutrients.
- o Dissolved oxygen in water.
- Different types of dissolved minerals in water.

Biotic parts:

- Producers:
- The producers are mainly aquatic plants that may be covered under water or moved on water surface like lotus, hydrilla, chara (a type of algae).
- The producers also contain very small aquatic plants (that are not to be seen) like algae having single cell.
- Consumers:
 - Consumers may be primary, secondary or tertiary depending upon climate conditions.
 - For example: small fishes, beetles (insect with black hard covering), mollusca (animal with soft body and hard cell), crustaceans like crab, tortoise, shrimp etc.

Decomposers:

- decomposers contains bacteria, fungi etc,
- They release minerals into the water by decomposing dead animal parts in the water itself.

a. Marine (or ocean) ecosystem:

- ➤ Oceans cover 70% of the earth's surface.
- There are five major ocean ecosystems in the world
 - o The Atlantic ocean ecosystem
 - The Pacific ocean ecosystem
 - o The Indian ocean ecosystem
 - o The Arctic ocean ecosystem
 - The Antarctic ocean ecosystem

Structure of ocean ecosystem:

> Abiotic parts:

O These are light, temperature, pressure, salinity (containing salts), tides (the sea's regular fall and rise) and currents (sea water movement in one direction).

Light is very important in controlling and spreading of marine animals.

Biotic parts:

o **Producers:**

The producers in an ocean ecosystem are mainly phytoplankton (small life forms that move on surface of water). For example: algae (that is not to be seen to eye), red algae and brown algae.

Consumers:

 The consumers in ocean ecosystems are mainly crustaceans, mollusca and small and big fishes along with some carnivorous fishes such as cod, haddock, etc.

Decomposers:

The decomposers in ocean ecosystem are mainly bacteria and fungi.

7. Describe the effects and conservation measures for grassland habitats.

Effects of loss of grassland habitats:

- Local people will not be able to protect their animal groups.
- ➤ Human beings are affected by the loss of animals
- > The wild grasses are used to develop new different types of crops
- New medicines can be made from wild grassland plants
- wild herbivores are used to develop new different types of animals

Conservation methods:

- A part of grassland in an area must be closed every year to protect wild grasses.
- Forest fires must be stopped and controlled in very short time
- Soil and water must be protected in hilly areas

Ecological succession



Ecological succession

- ♣ The gradual development of animals and plants in an area to form stable communities over a period of time is called ecological succession.
- ♣ In the process of succession, the plants, animals and ecosystem present in an area will gradually change.
- ♣ The stable community is formed after many thousands of years due to ecological succession.
- ♣ There are two types of ecological succession:

> Primary Succession:

- In this process the decomposed land will be converted into a forest or grassland ecosystem over a period of time.
- The land is decomposed by landslides, earth quakes, floods etc.

> Secondary Succession:

- In this process the well structured ecosystem will be converted into a decomposed land or other type of ecosystem by natural or manmade activities.
- The ecological succession may take place in forests, ponds, lakes or grasslands.

Process of ecological succession:

- ♣ The process of ecological succession consists of four steps.
 - Nudation
 - > Invasion
 - Competition
 - Stabilization

4 Nudation:

This is the process of development of a bare area not having any plant or animal population due to many reasons like landslides, clearing of forests, overgrazing etc.

4 Invasion:

- o The process of successful establishment of new animals and plants in the bare area.
- o Invasion is completed in three stages.
- Migration(dispersal)
 - ❖ In this process, the seeds of plants and animals reach the bare area by air, water, animals and man.
- Ecesis (establishment)
 - ❖ The successful establishment of new plants and animals in bare area is called ecesis.
- Aggregation.
 - ❖ The increase of number of animals and plants in bare is called aggregation.

Competition:

As the population of the animals and plants increases, they are not able to get enough food, water, and place in that limited area.

🖶 Stabilization:

- After all these stages, the remaining animals and plants completely establish themselves in the area and the ecosystem attains stability.
- These plants and animals exist in the ecosystem as long as the environmental, climatic, and biotic conditions remain unchanged.

Unit - IV

POLLUTION

1

- Pollution may be defined as the presence of any substance (solid, liquid, or gas) or agent (noise or heat) in the atmosphere in such a concentration that may tend to be injurious to the environment and affect living as well as non living things present in it.
- Pollution can take many forms. Pollution of the air we breathe, the water we drink, and the ground where we grow our food, and even the increasing level of noise we hear every day, all contribute to health problems and lead to a poorer quality of life.

Air pollution

- Air pollution refers to the presence of certain contaminants or pollutants in the atmosphere, which may possess undesirable characteristics, may be present in large quantities, or may remain in the atmosphere for long periods of time and hence may haves detrimental effects on the survival and normal functioning of human beings, plants and animals.
- Air pollution is one of the most dangerous forms of environmental pollution in current times. As a result of natural and man-made activities gases such as CO, SO2, H2S and oxides of Nitrogen, etc. are continuously released into the atmosphere and get dispersed in the air and causes health hazards to all organisms.
- The heavily polluted air is a result of natural and man-made pollution. Air pollutants are present in the atmosphere in concentrations that disturb the dynamic equilibrium of the atmosphere and thereby affect the human beings and the environment.

Sources of Air pollution:

- The pollutants are neither formed nor distributed locally or regionally. Hence the sources of pollutants are classified as point source or non point source.
 - Point source: pollution caused by emission of gases from an industry through chimney
 - Non point source: pollution caused by automobile discharge.
- In both cases the pollutants are carried to faraway places through air currents.
- For example, sulphur dioxide emissions in the United Kingdom causing acid rain in Scandinavia. The dust from the Sahara Desert reaching West Germany through air currents.
- However sources of air pollutants can be broadly classified into
 - 1. Natural sources 2. Man-made or anthropogenic sources.

1	N	atın	ral	co	urces
1.	17	atu	lai	50	urces

- Natural disasters such as cyclones, volcanic eruptions, earthquakes, forest fires, pollen grains, etc. cause suspension of dust particles and ash in air and cause air pollution.
- Various gases are also released into the atmosphere as a result of natural processes;
- Ex. methane gas is released in natural gas fields due to decay of organic matter, Radon gas is released due to radioactive decay within the earth's crust, and smoke and carbon monoxide are emitted during forest fires.

2. Man-made or anthropogenic sources:

Population Explosion: increase in population will create global warming and emission of green house gases. It also cause over exploitation of natural resources. It also result increase in demand for food followed by the need for more land for cultivation thus causing destruction and loss of forest cover.

1

•	Burning of fossil fuels and fires : burning of conventional fossil fuels such as coal, lignite, petroleum and
3 ;	Vehicular discharges: about 75% of the air pollution is caused by automobile emissions. Automobiles run mainly on petrol or diesel. They pollute the air not only with exhaust gases but also with tiny bits of lead from tetraethyl lead that is contained in gasoline.
	Rapid industrialization : the advancement in science had led to the establishment of several industries such as the chemical industry, paper and pulp mills, cotton mills, metallurgical plants, petroleum and oil refineries, mining, synthetic rubber industries. These industries are responsible for 20% of the air pollution.
	Thermal power stations
3;	Modern Warfare: To a large extent, radioactive rays from Nuclear reactors, Nuclear explosions and modern war explosives cause extensive air pollution and suffering to mankind.
	Agricultural activities : Different types of insecticides, pesticides and herbicides used in agriculture pollute the air
2)	Disposal of garbage
3,	Smoking: smoking of cigarettes and tobacco products causes many diseases. Non smokers living or working around smokers are also vulnerable to health problems.
Types Types	s of Air pollutants:
Prima	 Primary pollutants Secondary pollutants A primary pollutant can be defined as a harmful chemical that directly enters the air and coming from known sources.

× ;	These are formed by both natural events and human actions.
× ;	There are five types of primary pollutants that lead to 90% of the global air pollution.
Thes	se are

- 1. Carbon oxides (CO, CO₂)
- 2. Nitrogen oxides ($NO_x = NO, NO_2, NO_3$)
- 3. Sulfur oxides (SO₂, SO₃)
- 4. Vapors of organic compounds
- 5. Small solid particles that move in air.
- 6. Hydrocarbons.

Secondary pollutants:

- These are formed when primary pollutants undergo chemical reaction among themselves.
- For example: Sulfuric acid, nitric acid, carbonic acid, fog (liquid water vapor), smog (dense smoky fog), Ozone, PAN(Peroxy Acetyl Nitrate)[it is formed when hydrocarbon radicals reacts with nitrogen dioxide]

Sources:

1. Carbon monoxide (CO):

- It is a color less, smell less and poisonous gas formed when fuels are incompletely burnt. About 80% CO is produced by automobile exhaust.
- It is the one of the waste gases coming out from the engines of cars and motor cycles etc.

2