

ENVIRONMENTAL STUDIES

for undergraduate courses



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ENVIRONMENTAL STUDIES

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PREFACE

Today, it is extremely important to have an understanding of environmental issues. This is because the human economy is engaged in a wide range of activities that are causing enormous damage to the ecosystems that sustain both our species and Earth's legacy of biodiversity.

All around us, this is witnessed by pollution, climate change, Global warming, deforestation, degradation of agricultural soil, extinctions and endangerment of species, and other damages.

Nevertheless, we need not be overly pessimistic. If our society takes constructive actions now, or at least soon, it will not be too late to prevent or repair many of these important environmental problems, which threaten the welfare of people and most other species. Within limits, humans are prescient creatures, and our society is capable of implementing a sustainable economy that can support our livelihoods as well as healthy ecosystems.

Within that context, this book was developed to help our students in universities and colleges to have an objective and well-informed understanding of important environmental issues.

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U.G. DEGREE COURSE

ENVIRONMENTAL STUDIES PROGRAMME
ABILITY ENHANCEMENT COMPULSORY COURSES
(AECC- Environmental Studies)

Syllabus with effect from the academic year 2018-2019
(i.e. for batch of candidates admitted to the course from the academic year 2017-18)

Credits: 2

II Year / III/IV Sem.

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; concept of sustainability and sustainable development.

Unit 2 : Ecosystem (2 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem:
Food chains, food webs and ecological succession, Case studies of the following ecosystem:
 - a) Forest ecosystem
 - b) Grassland ecosystem
 - c) Desert ecosystem
 - d) Aquatic ecosystem (ponds, stream, lakes, rivers, ocean, estuaries)

Unit 3: Natural Resources : Renewable and Non – renewable Resources (6 lectures)

- Land resources and land use change: Land degradation, soil erosion and desertification.
- Deforestation : Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over –exploitation of surface and ground water, floods, droughts, conflicts over water (international and inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation (8 lectures)

- Levels of biological diversity: genetics, species and ecosystem diversity, Biogeographic zones of India: Biodiversity patterns and global biodiversity hot spots
- India as a mega- biodiversity nation, Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts, biological invasions; Conservations of biodiversity: In-situ and Ex-situ Conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution (8 lectures)

- Environmental pollution: types, causes, effects and controls: Air, Water, soil and noise Pollution.
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies.

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Unit 6: Environmental Policies & Practices (8 lecturers)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human Wildlife conflicts in Indian context.

Unit 7: Human Communities and the Environment (7 lectures)

- Human population growth, impacts on environment, human health and welfare.
- Resettlement and rehabilitation of projects affected persons; case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Environmental movements : Chipko, Silent Valley, Bishnois of Rajasthan.
- Environmental ethics : Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies(e.g. CNG Vehicles in Delhi)

Unit 8 : Field Work (6 lectures)

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

(Equal to 5 Lectures)

Suggested Readings:

1. Carson , R. 2002.Silent Spring, Houghton Mifflin Harcourt.
2. Gadgil , M.,& Guha, R. 1993.This Fissured Land: An Ecological History of India. Univ.of California Press.
3. Glesson, B. and Low, N.(eds.)1999. Global Ethics and Environment, London, Routledge.
4. Gleick,P.H.1993.Water Crisis. Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env.Institute, Oxford Univ.Press.
5. Groom, Martha J., Gary K.Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates,2006.
6. Grumbine,R.Edward, and Pandit,M.K2013.Threats from India's Himalayas dams .Science,339:36-37
7. McCully,P.1996.Rivers no more :the environmental effects of dams(pp.29-64).Zed books.
8. McNeill,John R.2000.Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum,E.P.,Odum, H.T.& Andrees,J.1971.Fundamental of Ecology. Philadelphia Saunders.
10. Pepper,I.L.,Gerba,C.P & Brusseau,M.L.2011.Environmental and Pollution Science. Academic Press.
11. Rao,M.N.& Datta,A.K1987.Waste Water Treatment. Oxford and IBH Publishing Co.Pvt.Ltd.
12. Raven,P.H.,Hassenzahl,D.M & Berg,L.R.2012 Environment.8th edition. John Willey & sons.

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13. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tirupathi 1992.
14. Sengupta, R. 2003. Ecology and Economics: An approach to sustainable development. OUP
15. Singh, J.S., Singh, S.P and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S.Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H (eds). 2013. Conservation Biology :Voices from the Tropics. John Willey & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C.E. 1971. Biology and water Pollution Control. WB Saunders.
19. Willson, E.O. 2006. The Creation: An appeal to save life on earth..New York: Norton.
20. World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press.

UNIT 1

INTRODUCTION TO ENVIRONMENTAL STUDIES

Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of human on environment. The word environment is derived from the French word 'environ' meaning surroundings. Hence, everything surrounding us is called "ENVIRONMENT".

Environment encompasses interactions with living things and their qualities as well as the relationships between water, air, and soil. Life sciences, which include botany, zoology, microbiology, biotechnology, genetics, and biochemistry, are related to environmental sciences.



ELEMENTS OF ENVIRONMENT

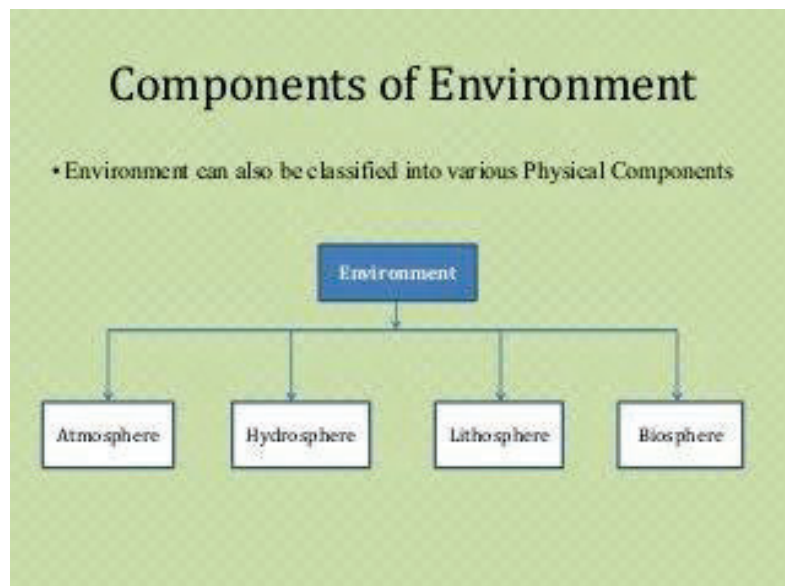
The environment is constituted by the interacting systems of physical, biological and cultural elements inter-related in

various ways, individually as well as collectively. These elements are:

1. **Physical Elements:** Physical elements are space, landforms, water bodies, climate, soils, rocks and minerals. They determine the variable character of the human habitat, its opportunities as well as limitations.
2. **Biological Elements:** Biological elements such as plants, animals, microorganisms and men constitute the biosphere.
3. **Cultural Elements:** Cultural elements such as economic, social and political elements are essentially man-made features, which make the cultural background.

COMPONENTS OF ENVIRONMENT

The basic components of the environment are atmosphere or the air, lithosphere or the rocks and soil, hydrosphere or the water, and the living component of the environment or the biosphere.



1. Atmosphere:

The thick gaseous layer surrounding the earth. It spreads up to 300 km above the earth's surface. Apart from gases there are water vapor, industrial gases, dust and smoke particles in suspended state, microorganism etc.

2. **Hydrosphere:** The Hydrosphere comprises all types of water resources namely oceans, seas, lakes, rivers, streams, reservoirs, polar icecaps, glaciers, and ground water. Oceans represent 97% of the earth's water and about 2% of the water resources is locked in the polar icecaps and glaciers. Only about 1% is available as fresh water as surface water in rivers, lakes, streams, and as groundwater for human use.

3. **Lithosphere:** Lithosphere is the outer mantle of the solid earth. It consists of minerals occurring in the earth's crusts and the soil e.g. minerals, organic matter, air and water.

4. **Biosphere:** Biosphere indicates the realm of living organisms and their interactions with environment, viz atmosphere, hydrosphere and lithosphere.

NEED FOR ENVIRONMENTAL STUDIES

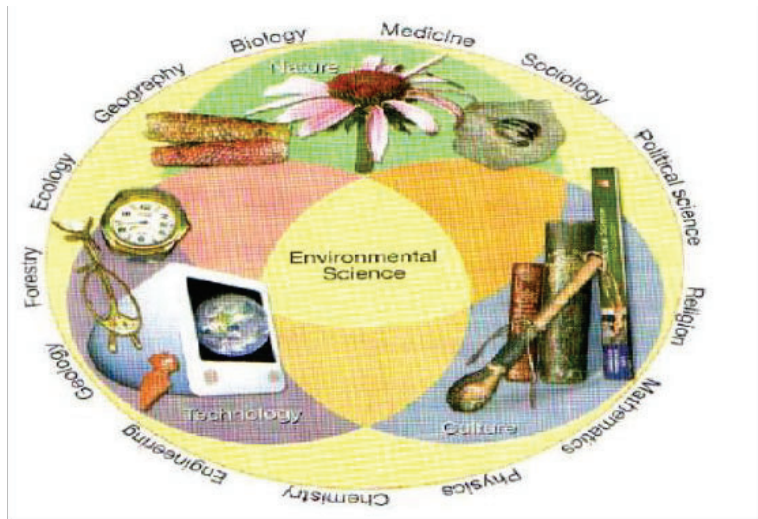
Nature for the environment sustains life. As a conscious and rational being, man needs to know the importance of the environment and help to retain the environment as healthy and productive as it can be. It is the environment that has made this beautiful world possible for human life. Hence, there is an ever-demanding need for environmental studies. The natural environment that mankind had before the onset of industrialization, urbanization, and exponential growth in population was expectedly healthy and resilient. Nature was able to replenish the loss of its resources, which was very limited. After the onset of modern civilization, the overall

health and efficiency of the natural environment started deteriorating gradually and went on to such an extent that nature has virtually lost its natural ability to replenish the loss of resources caused by man.

Environmentalists, geographers and biologists across the world are constantly endeavoring for a sustainable solution to restore a sustainable environment. There is a need to focus on environmental management, laws governing environment protection, pollution and recycling of non-bio-degradable material, etc. There is also a need for careful and cautious use of natural resources in the present time to establish sustainability in every aspect of nature.

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Environment studies is a multidisciplinary subject where different aspects are dealt with 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. The complex relationship exists in our natural environment among people, animals, other organisms, water, soil, air, tree, ocean, and so on. The interconnections are numerous and involve many different disciplines. We need inputs from diverse disciplines such as biology, botany, zoology, soil science, technology oceanography, atmospheric science, economics, sociology, anthropology and ethics. Environmental studies involve educating the people for preserving the quality of environment.



SCOPE OF ENVIRONMENTAL STUDIES

The scope of environmental studies is very wide and it deals with many areas like i) Conservation of natural resources, ii) ecological aspects, iii) pollution of the surrounding natural resources, iv) controlling the pollution, v) social issues connected to it, and vi) impacts of human population on the environment.

1. Developing an awareness and sensitivity to the total environment and its related problems.
2. Motivating people for active participation in environmental protection and improvement.
3. Developing skills for active identification and development of solutions to environmental problems.
4. Imbibe and inculcate the necessity for conservation of natural resources.
5. Evaluation of environmental programmes in terms of social, economic, ecological and aesthetic factors.

IMPORTANCE OF ENVIRONMENTAL STUDIES:

Environmental studies make us aware about the importance of protection and conservation of our mother earth and about the destruction due to the release of pollution into the environment. The increase in human and animal population, industries and other issues make the survival cumbersome. A great number of environment issues have grown in size and make the system more complex day by day, threatening the survival of mankind on earth.

Life originated on the surface of the earth 3500 million years ago. But now, human population has been increasing at an alarming rate, depleting the once abundant natural resources. In 1950, the world population was 2.5 billion; in 1994, it became 5.6 billion and in 2050 it would be 9 billion! The natural resources are depleted due to over consumption by the ever increasing population. The resources are limited on earth but the methods of exploiting them are on the increase. This results in more environmental pollution.

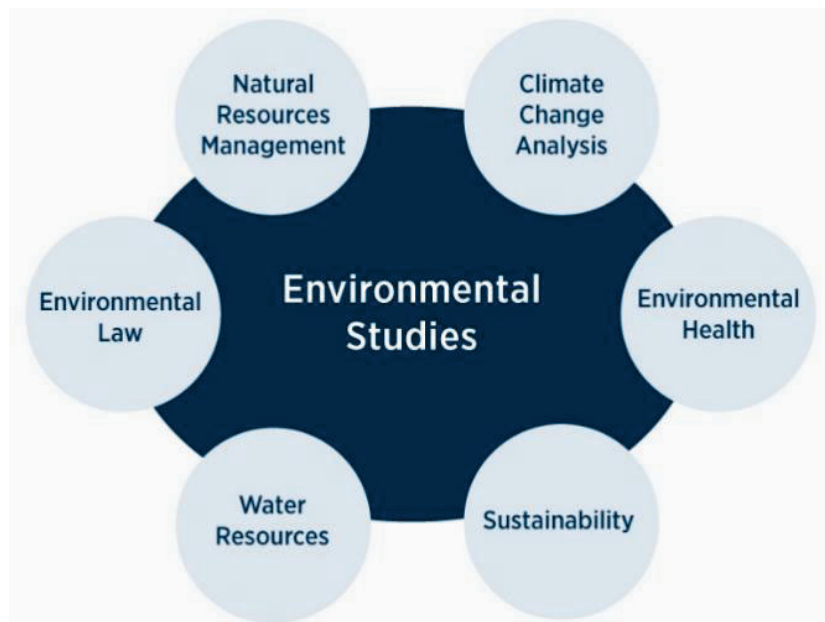
Environmental study enables to pursue sustainable development. It motivates students in community action and makes them participate in activities relating to environmental protection.



TYPES OF ENVIRONMENT:

The two types of environment are:

- (a) **Natural Environment:** The natural environment comprises (i) Atmosphere (500kms above the surface of earth), (ii) Hydrosphere (surface and ground water resources on earth's crust), (iii) Lithosphere (earth's crust which includes rocks and soil) (iv) Biosphere (region where life exists on earth between 10,000 m below sea level and 6,000 m above sea level).
- (b) **Man-made Environment:** The man-made environment is the environment created by humans. It includes (i) Human-groups (religions and communities) 2. Material infrastructure built by man (rural and urban settlements, railways, roads etc. (iii) Production relationships (factors of production-primary, secondary and tertiary activities). (iv) Institutional systems (education, commerce and marketing).



CONCEPT OF SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT:

Sustainable development is the practice of developing land and construction projects in a manner that reduces their impact on the environment by allowing them to create energy efficient models of self-sufficiency. This can take the form of installing solar panels or wind generators on factory sites, using geothermal heating techniques or even participating in cap and trade agreements. *“Sustainable development is development that meets the needs of the present, without compromising the ability of future generations to meet their own needs.”* -

Brundtland Commission in its 1987 report “Our Common Future”, Sustainable development has three goals

- a) To minimize the depletion of natural resources
- b) To promote development without causing harm to the environment
- c) To make use of environmentally friendly practices.

Many of the projects that are rooted in environmental sustainability will involve replanting forests, preserving wetlands and protecting natural areas from resource harvesting.

Review Questions

1. Define the terms environment and environmental science.
2. What is Environmental Studies? Explain.
3. State the scope of environmental education.
4. Explain the importance of Environmental Studies.
5. Explain the multidisciplinary nature of Environment Studies.

UNIT 2

ECOSYSTEM

An ecosystem is a group of living communities of species interacting with one another and with their non-living environment, exchanging energy and matter. Ecology is the study of living entities or organisms, as well as their interactions and relationships with their surroundings. The ecosystem, on the other hand, is a subset of ecology that encompasses all of the complex interactions between living and non-living organisms in a community. The term ecosystem was first introduced by Sir Arthur Tensely (1935).

An **ecosystem** consists of a community of organisms together with their physical environment. Plants, animals, insects, microorganisms, rocks, soil, water and sunlight are major components of ecosystems.

TYPES OF ECOSYSTEMS

An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles. The two types of ecosystems are

1. Terrestrial Ecosystem

Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

- **Forest Ecosystem**

Forest ecosystem consists of several plants, particularly trees, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink.

- **Grassland Ecosystem**

In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands and tropical or savanna grasslands are examples of grassland ecosystems.

- **Tundra Ecosystem**

Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce. These are covered with snow for most of the year. Tundra type of ecosystem is found in the Arctic or mountain tops.

- **Desert Ecosystem**

Deserts are found throughout the world. These are regions with little rainfall and scarce vegetation. The days are hot, and the nights are cold.

2. Aquatic Ecosystem

Aquatic ecosystems are ecosystems present in a body of water. These can be further divided into two types, namely:

- **Freshwater Ecosystem**

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.

- **Marine Ecosystem**

The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

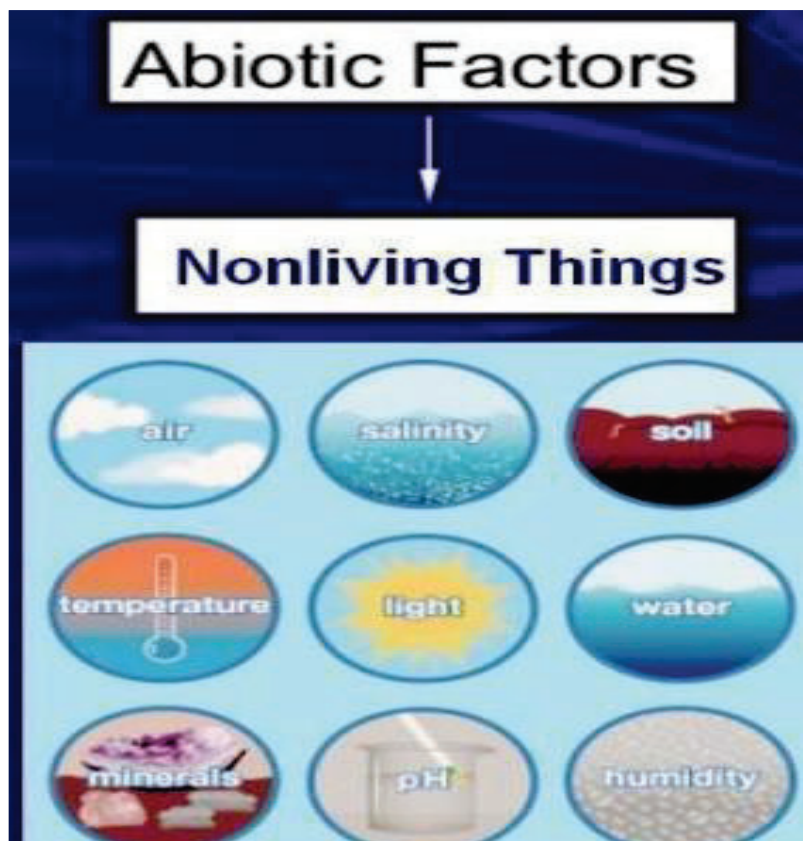
STRUCTURE AND FUNCTION OF ECOSYSTEM

The structure of an ecosystem is basically a description of the organisms and physical features of environment including the amount and distribution of nutrients in a particular habitat. It also provides information regarding the range of climatic conditions prevailing in the area. From the structure point of view, all ecosystems consist of the following basic components:

1) Abiotic factor

An abiotic factor is a non-living part of an ecosystem that shapes its environment. In a terrestrial ecosystem, examples might include temperature, light, and water. In a marine ecosystem, abiotic factors would include salinity and ocean currents. Abiotic and biotic factors work together to create a unique ecosystem. The five common abiotic factors are

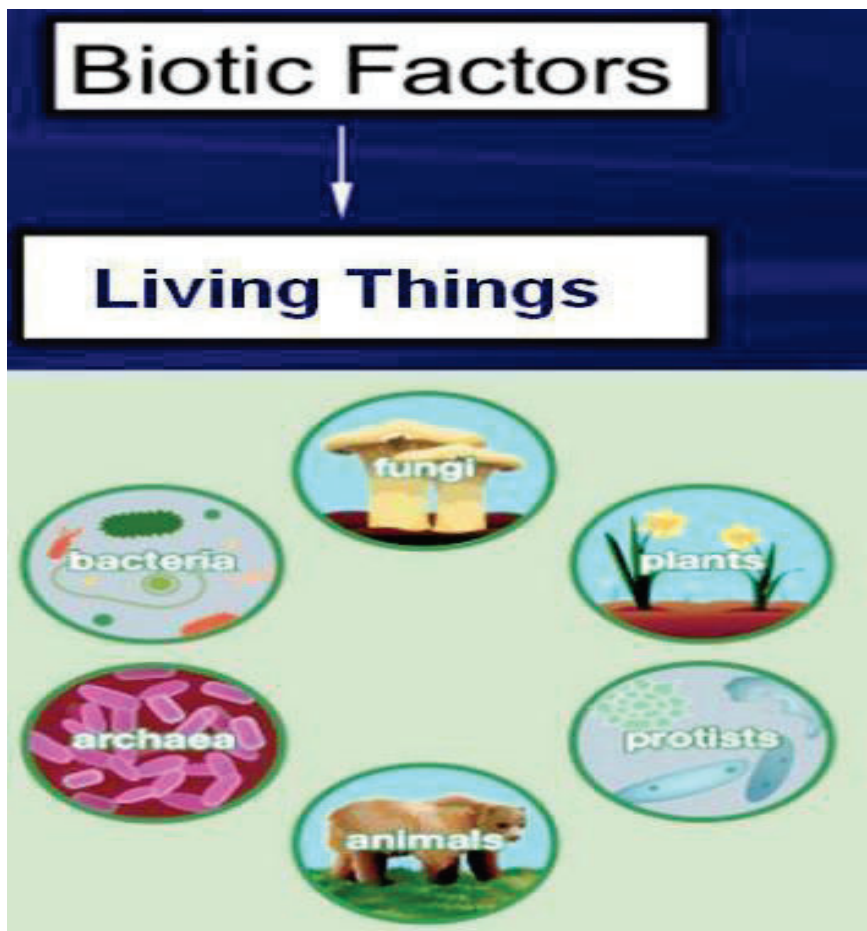
- **Atmosphere**
- **Chemical elements**
- **Sunlight/Temperature**
- **Wind**
- **Water**



2) Biotic factors

A biotic factor is a living organism that shapes its environment. In a freshwater ecosystem, examples might include aquatic plants, fish, amphibians, and algae. The six biotic or living factors are

1. Producers
2. Consumers
3. Herbivores
4. Carnivores
5. Omnivores
6. Decomposers.



FUNCTIONS OF ECOSYSTEM

The Functional components that work together in an ecosystem are

- **Productivity** – It refers to the rate of biomass production.
- **Energy flow** – It is the sequential process through which energy flows from one trophic level to another. The energy captured from the sun flows from producers to consumers and then to decomposers and finally back to the environment.
- **Decomposition** – It is the process of breakdown of dead organic material. The top-soil is the major site for decomposition.
- **Nutrient cycling** – In an ecosystem nutrients are consumed and recycled back in various forms for the utilisation by various organisms.

HOW DO NATURAL ECOSYSTEMS WORK?

Natural ecosystems are “balanced” systems. This means the interactions between the different organisms that make up the ecosystem contribute to a certain stability. Ecosystems are constantly evolving as they are based on dynamic processes that are constantly changing.

WHY IS PRESERVING ECOSYSTEMS IMPORTANT?

Like all other living beings, humans are dependent on natural ecosystem services to survive. We need it to get the food we eat, the water we drink and to transform raw materials into our everyday products. So in order to sustain our living conditions, it's truly important that we preserve natural ecosystems. For example, the agriculture that provides our food depends on the characteristics of a specific ecosystem. Cereals or vegetables grow only under certain conditions of

temperature and humidity. They also need certain natural processes, such as pollination, to take place. If we change these characteristics intensely, there is the risk that we aren't able to produce what we produce today, or at least not in the same way.

POTENTIAL THREAT TO ECOSYSTEMS

1. Environmental Pollution

Air, land, water, and soil pollution simply destroy the health of crucial ecosystems. Be it as a result of natural or anthropogenic causes, pollution potentially releases noxious substances and destructive chemicals into the environment that damage the health of living things and degrades the nature of non-living things.

In an aquatic system, for instance, water pollution can disturb the ecological balance by accelerating plant and nutrient growth thereby causing death of fishes because of suffocation resulting from dissolved oxygen depletion.

2. Over-exploitation of Natural Resources

The exploitation of the natural resources to the point of diminishing returns has significantly destroyed the ecosystem. Activities such as over hunting, overfishing, over mining, and excessive logging have led to a reduction in community structures, population distributions, and species breeding. For instance, excessive fishing has led to population collapse of more than a third of all fish species and some are currently endangered.

3. Invasive Species

Foreign species that find a way into an ecosystem, either by human or natural initiation can wreak serious havoc on the native members of the ecosystem. Whenever this

happens, the native species can be wiped out completely or may find it tough to survive.

Invasive species often compete for food with the native species and can also alter the habitat. This gradually destroys ecosystems and leads to the extinction of species.

4. Eutrophication

Eutrophication is the excessive concentration of chemical nutrients in water bodies to an extent that it encourages the dense growth of plant life and algae blooms. Based on the degree of eutrophication, the effects are depletion of oxygen, extensive deterioration of water quality, poisoning of seafood and degradation of recreational opportunities. As a result, it affects the survival of fishes and other aquatic life forms.

5. Climate Change and Global Warming

Changes in climates and global temperatures directly impact the abiotic factors essential for sustaining the biotic elements. The present rate of rising global temperatures is destroying and altering the coral reefs, mountain regions, water cycles, which are vital ecosystems resources. For instance, different species requires particular abiotic factors to thrive. If global warming and climate change continue, 10% of the entire world species might go extinct by 2050.

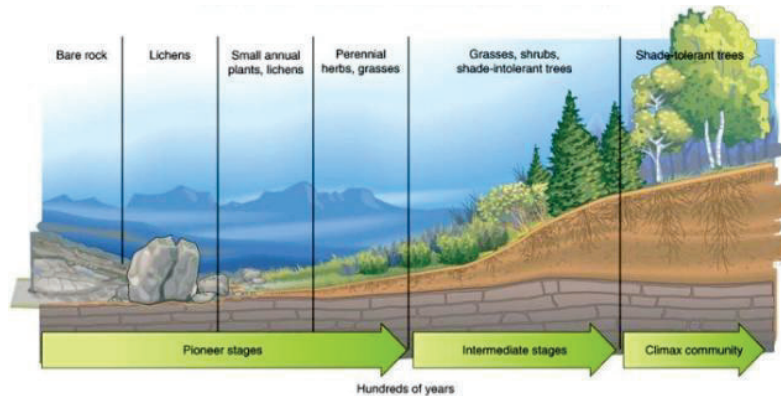
ECOLOGICAL SUCCESSION, FOOD CHAIN, FOOD WEB

ECOLOGICAL SUCCESSION

- **Primary succession**

It is one of two types of biological and ecological succession of plant life, occurring in an environment in which new substrate devoid of vegetation and other

organisms usually lacking soil, such as a lava flow from a retreating glacier, is deposited. It is rare and takes a long time to generate



- **Secondary succession**

Development of a community which forms after the existing natural vegetation that constitutes a community is removed, disturbed or destroyed by a natural event like hurricane or forest fire or by human related events like tilling or harvesting land. A secondary succession is relatively fast as, the soil has the necessary nutrients as well as a large pool of seeds and other dormant stages of organisms.

FOOD CHAIN

Plants are eaten by insects, which are eaten by frogs, these frogs are eaten by fish, which are eaten by human beings. This sequence is known as the Food chain. Plant > insect > frog > fish > human. Each step in the food chain is called a Trophic level.

Types of food Chain

- **Grazing** : Starts with green plants e.g. Grass > Grasshoppers > Birds > Snakes > Hawks

- Parasitic: Also starts with green plants but here smaller organisms depending on larger organisms e.g. Grass > cow > lice
- Detritus*/saprophytic: Starts with dead plant/animal/waste material > decomposers

Trophic Level	Grassland Biome	Pond Biome	Ocean Biome
Primary Producer	grass ↓	algae ↓	phytoplankton ↓
Primary Consumer	grasshopper ↓	mosquito larva ↓	zooplankton ↓
Secondary Consumer	rat ↓	dragonfly larva ↓	fish ↓
Tertiary Consumer	snake ↓	fish ↓	seal ↓
Quaternary Consumer	hawk	raccoon	white shark

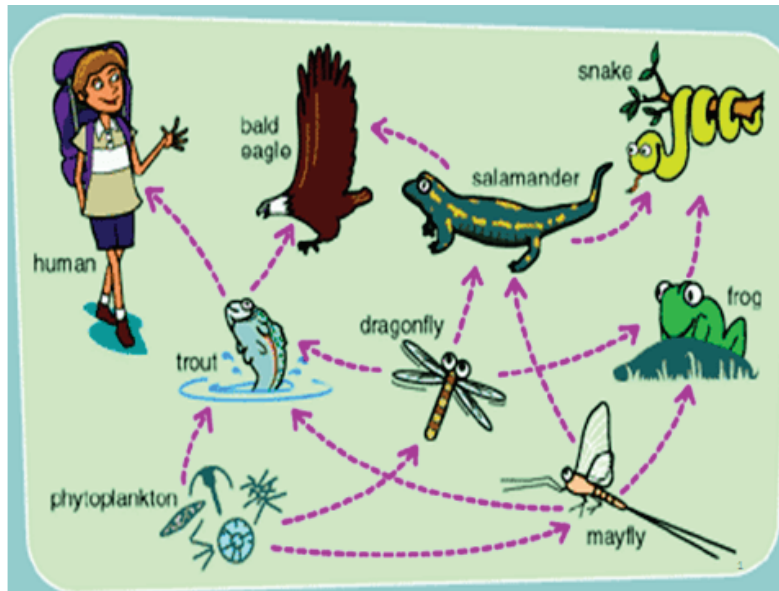
Trophic level

- Trophic level to which an organism belongs, indicates how far it is away from plants in the food chain
- Energy Flow in food chain is unidirectional, means energy flow can never be from carnivores to herbivores or herbivores to producers
- In grazing food chain, primary source of energy is living plant biomass while in detritus food chain, source of energy is dead organic matter or detritus

FOOD WEB

Food web is a connection of multiple food chains. Food chain follows a single path whereas the food web follows multiple paths. Food chain assumes the isolated linear line. But in real life, frog could be eating other insects apart from

grasshopper. Fish could be eating smaller fishes apart from frog. So there exists an interconnected Network of (Food Chain + Food Chain + Food chain...). This interconnected network of food chains is known as food web.



REVIEW QUESTIONS

1. What is the ecosystem?
2. What are the different types of ecosystems?
3. What are the functional components of an ecosystem?
4. What are the threats to Ecosystem?
5. What is the structure of the ecosystem?
6. Which is the largest ecosystem in the world?
7. What are the major functions of an ecosystem?
8. What makes a good ecosystem?
9. State the non-living things that includes in an ecosystem?

UNIT -3

NATURAL RESOURCES- RENEWABLE & NON-RENEWABLE

Natural resources can be defined as the resources that exist on the planet independent of human actions. These are the resources that are found in the environment and are developed without the intervention of humans. Common examples of natural resources include air, sunlight, water, soil, stone, plants, animals and fossil fuels.



Natural resources are naturally occurring materials that are useful to man or could be useful under conceivable circumstances such as technological, economic or social circumstances or supplies drawn from the earth, supplies such as food, building and clothing materials, fertilizers, metals,

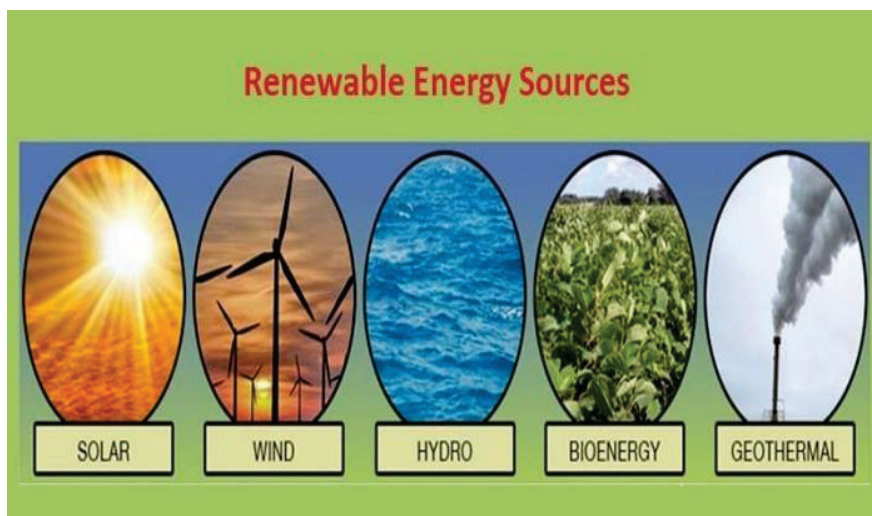
water and geothermal power. For a long time, natural resources were the domain of the natural sciences.

CLASSIFICATION OF NATURAL RESOURCES:

According to Odum (1971), natural resources can be divided into two categories such as

1. Renewable natural resources

A renewable resource is one that can be used repeatedly and does not run out because it is naturally replaced. Examples of renewable resources include solar, wind, hydro, geothermal, and biomass energy. Some examples of renewable resources though they do not have a 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 fibre) 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 are inexhaustible on the human scale.

Characteristics of renewable resources

- These types of resources have the ability to regenerate themselves easily.
- The process of regeneration of renewable energy involves ecological processes for a specific time period.
- If renewable energy is utilized at a very high speed that is higher than the environment's ability to refill it, then it may become non-renewable energy in the near future.

Types of renewable energy sources

- ❑ **Wind power:** leverages the power of wind motion to generate electricity, created by the uneven heating of Earth's surface.
- ❑ **Solar power :** uses energy from the sun to generate electricity and heat
- ❑ **Hydropower:** utilizes fast-moving water to spin turbines and generate electricity
- ❑ **Biomass:** generates electricity from organic plant matter.
- ❑ **Geothermal:** leverages heat from inside the earth to generate electricity

2. Non-Renewable natural resources

Non-renewable energy resources include coal, natural gas, oil, and nuclear energy. Once these resources are used up, they cannot be replaced, which is a major problem for humanity as we are currently dependent on them to supply most of our energy needs. Once a non-renewable resource is consumed, it is permanently lost. Then we have to find a substitute for it or abandon it.



Non-Renewable Resources is divided into

1) Re-Cyclable

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.)

2) Non-Re Cyclable

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

Characteristics of Non-Renewable Energy

- Non renewable energy sources are not easily replenished.
- Non renewable energy sources deplete over time.
- Such sources are not environment friendly.
- Logistical issues as it requires transportation for refining.

Types of Non-renewable energy sources

- **Coal:** Coal is created by compressed organic matter, and it contains carbon and hydrocarbon matter. The main types of coal are anthracite, lignite, bituminous coal, and sub-bituminous coal.
- **Natural gas:** Natural gas is a gaseous non-renewable resource. Natural gas primarily consists of methane but may also contain other forms of natural gas such as propane, ethane and butane.
- **Crude oil:** Crude oil, also referred to as petroleum oil, is the only non-renewable resource that is extracted in liquid form. It is found between the layers of the earth's crust, or between the rocks.
- **Nuclear energy:** It is primarily obtained through the mining and refining of Uranium which is found in small quantities and miners often gather the Uranium deposits for refining and purification.

REVIEW QUESTIONS

1. Mention the problems of Natural resources?
2. Briefly explain about renewable and non-renewable resources?
3. Advantage &disadvantage of non-renewable energy?

LAND RESOURCES AND LAND USE CHANGE

Landforms such as hills, valleys, plains, river basins and wetlands include different resource generating areas people living depend on. Many traditional farming societies had ways of preserving areas from which they used resources. Land resources include natural vegetation, wild life, human life, economic activities, transport and communication. Moreover, most of our basic needs like food, clothing and shelter comes from land.



LAND DEGRADATION

Land degradation is the process of deterioration of soil or loss of fertility of soil. The causes of land degradation can be divided into natural hazards, direct causes, and underlying causes. Natural hazards are the conditions of the physical environment which lead to the existence of a high degradation hazard, for example steep slopes as a hazard for water erosion.

Causes of land degradation

- **Population:** The indirect activities included pressure on agricultural intensification and population growth. About 220 million hectares of tropical forest have been degraded 1975 and 1990 mainly for food production. With the increase in population, more land is needed for producing food, fibre and fuel wood leading to increase

pressure on the limited land resources. Therefore, the land gets degraded due to over exploitation.

- **Human Activities:** Human activities are leading to land degradation directly or indirectly which includes deforestation, overgrazing by livestock, wrong irrigation practices, urban sprawl and commercial development, pollution from industries, quarrying, and mining activities, problems arising from planning and management of canal irrigation etc.
- **Urbanization:** Increased urbanization due to population growth reduces the agricultural land. To compensate for loss of agricultural land, new lands comprising of natural ecosystems such as forests are cleared. Therefore, urbanization leads to deforestation which in-turn affects millions of plant and animal species.
- **Fertilizers and Pesticides:** Increased application of fertilizers and pesticides are needed to increase farm output in new lands thereby leading to pollution of land, water and soil degradation.
- **Damage to topsoil:** Increase in food production generally leads to damage of top soil through nutrient depletion.

Impact of land degradation

- ☐ Loss of soil organic matter and nutrients.
- ☐ Loss of soil structure.
- ☐ Loss of soil biodiversity.
- ☐ Loss of water holding capacity and water infiltration.
- ☐ Soil pollution.
- ☐ Reduced yields of crops.
- ☐ Reduced land value and resilience to future events.

- ☐ Impact on food security.
- ☐ Reduces ability to adapt to climate change.

SOIL EROSION:

‘Soil erosion’ has been defined as the gradual removal of the topsoil by running water, wind, glacier, sea-waves and animals. – Soil erosion is a universal phenomenon.

Types of soil erosion

1. **Sheet erosion:** Hill slopes are prone to sheet erosion and rill erosion. The amount of hillslope erosion largely depends on how the land is used. Sheet erosion occurs when a thin layer of topsoil is removed over a whole hillside paddock and may not be readily noticed.
2. **Rill erosion:** Rill erosion occurs when runoff water forms small channels as it concentrates down a slope. These rills can be up to 0.3 m deep.
3. **Gully erosion:** Gully erosion happens when runoff concentrates and flows strongly enough to detach and move soil particles. Gullies may develop in watercourses or other places where runoff concentrates.

Harmful Effects of Soil Erosion:

- ☐ Loss of fertile topsoil leading to gradual loss of soil fertility and agricultural productivity.
- ☐ Loss of mineral nutrients from soil through leaching and flooding.
- ☐ Loss of soil ability to hold water and sediment
- ☐ Sediment runoff can pollute water sources and kill aquatic life
- ☐ Lowering of the underground water table and decrease in the percentage of soil moisture.

- ☐ Drying of vegetation and extension of arid lands.
- ☐ Increase in frequency of droughts and floods.
- ☐ Silting of river and canal belts.
- ☐ Recurrence of landslides.
- ☐ Adverse effect on economic prosperity and cultural development.

DESERTIFICATION:

Desertification is a type of land degradation in which a relatively dry area of land becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and the over exploitation of soil through human activity. Desertification is a process whereby the productive potential of arid or semiarid lands falls by ten percent or more. Desertification is characterized by the vegetation and loss of vegetal over, depletion of groundwater, salinization and severe soil erosion.



Causes of desertification

The two main causes of desertification include

1. **Climatic variations:** Climate change, drought, moisture loss on a global level
2. **Human activities:** It include overgrazing, deforestation and removal of the natural vegetation cover (by taking too much fuel wood) , agricultural activities in the vulnerable ecosystems of arid and semi-arid areas, which are thus strained beyond their capacity. These activities are triggered by population growth, the impact of the market economy and poverty.

REVIEW QUESTIONS

1. Briefly explain about land resources
2. What is Desertification?
3. What is Land Degradation?
4. What is Soil Erosion & its Types?

DEFORESTATION

The total forest area of the world in 1990 was estimated to be 7000 million hectares which was reduced to 2890 million hectares in 1975 and fell down to just 2300 million hectares by 2000. Deforestation rate is relatively less in temperate countries, but it is very alarming in tropical countries where it is as high as 40-50 percent and at the present rate it is estimated that in the next 60 years we would lose more than 90 percent of our tropical forests. The forested area in India seems to have stabilized since 1982 with 0.04% decline annually between 1982-90.



Deforestation is the permanent destruction of indigenous forests and woodlands. Deforestation has resulted in the reduction of indigenous forests to four fifth of their pre-agricultural area. Indigenous forests now cover 21% of the earth's land surface.

Major causes of Deforestation

- **Shifting cultivation:** An estimated 300 million people are living as shifting cultivators who practice slash and burn agriculture and are supported to clear more than 5 lakh of forests for shifting cultivation annually.
- **Fuel requirements:** Increasing demands for fuel wood by the growing population in India alone has shot up to 300-500 million tons in 2001 as compared to just 65

million tons during independence, thereby increasing the pressure on forests.

- **Raw materials for industrial use:** Wood for making boxes, furniture, railway-sleepers, plywood, match boxes, pulp for paper industry etc. have exerted tremendous pressure on forests. Plywood is in great demand for packing tea for Tea industry of Assam while fir tree wood is exploited greatly for packing apples in J&K.
- **Development projects:** Massive destruction of forests occurs for various development projects like hydroelectric projects, big dams, road construction, mining etc.
- **Growing food needs:** To meet the demands of a rapidly growing population, agricultural lands and settlements are created permanently by clearing forests.
- **Overgrazing:** The poor in the tropics mainly rely on wood as a source of fuel leading to loss of tree cover and the cleared lands are turned into the grazing lands. Overgrazing by the cattle leads to further degradation of these lands.

Major consequences of deforestation

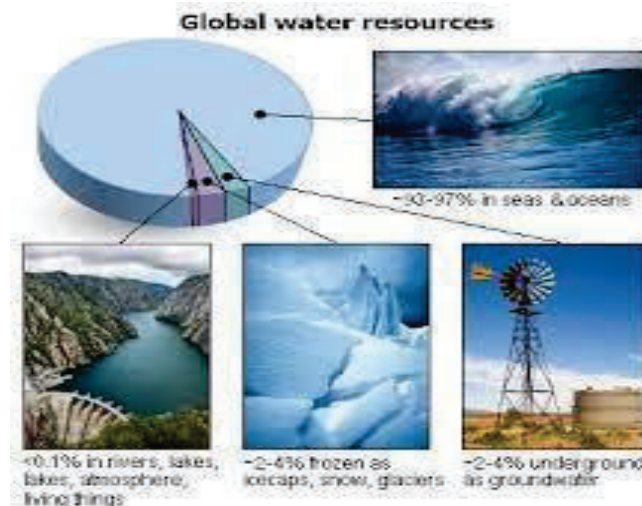
- It threatens the existence of many wildlife species due to destruction of their natural habitat.
- Biodiversity is lost and along with that genetic diversity is eroded.
- Hydrological cycle gets affected, thereby influencing rainfall.
- Problems of soil erosion and loss of soil fertility increase.
- In hilly areas it often leads to landslides

REVIEW QUESTIONS

1. What is Deforestation?
2. Major causes of Deforestation?

WATER

Water is an indispensable natural resource on this earth in which all life depends. About 97% of the earth's surface is covered by water and most of the animals and plants have 60-65% water in their body. Water is characterized by certain unique features which make it a marvellous resource.



It exists as a liquid over a wide range of temperature i.e., from 0°C to 100°C . It has the highest specific heat, due to which it warms up and cools down very slowly without causing jerks to aquatic life. It has a high latent heat of vaporization. Hence, it takes a huge amount of energy to get vaporized. That's why it produces a cooling effect as it evaporates. It is an excellent solvent for several nutrients. Thus, it can serve as a very good carrier of nutrients, including oxygen, which is essential for life. But it can also easily dissolve various pollutants and become a carrier of pathogenic microorganisms. Due to high surface tension and cohesion it can only easily rise through great heights through the trunk even in the tallest of the trees like Sequoia. It has anomalous expansion behaviour i.e., as it freezes; it expands instead of contracting and thus becomes lighter. It is because of this property that even in extreme cold, the lakes freeze only on the surface. Being lighter the ice keeps floating, whereas the bottom water remain at a higher

temperature and therefore can sustain aquatic organisms even in extreme cold. The water we use keeps on cycling endlessly through the environment, which we call as Hydrological Cycle.

WATER USE AND OVER-EXPLOITATION:

Water is essential for life. Most of the life processes take place through water contained in the body. Uptake of nutrients, their distribution in the body, regulation of temperature and removal of wastes are all mediated through water.

WATER: A PRECIOUS NATURAL RESOURCE:

Water is very abundant on this earth; it is very precious. Out of the total water reserves of the world, about 97% is salty water (marine) and only 3% is fresh water. Even this small fraction of freshwater is not available to us, most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of groundwater and surface water.

Overuse of groundwater for drinking, irrigation and domestic purposes has resulted in rapid depletion of groundwater in various regions leading to lowering of water table and drying of wells. Pollution of many groundwater aquifers has made the wells unfit for consumption. Rivers and streams have long been used for discharging the wastes. Most of the civilizations have grown and flourished on the banks of rivers, but unfortunately, growth in turn has been responsible for pollution of the rivers.

1) Groundwater

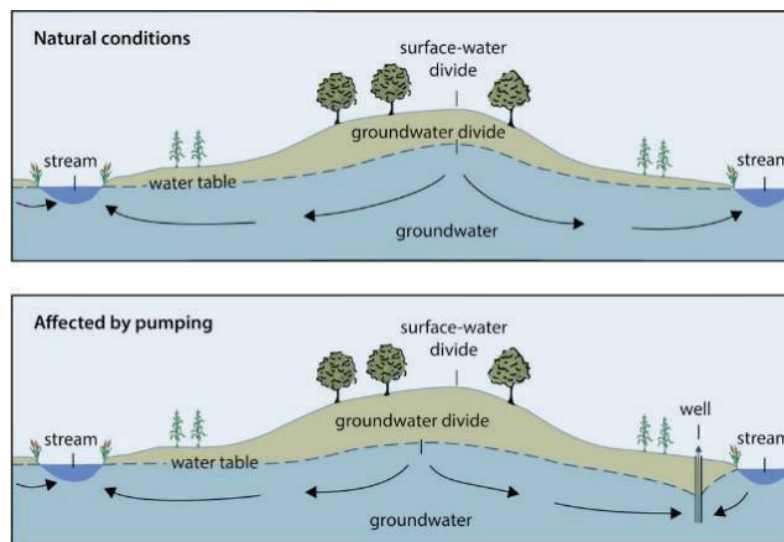
About 9.86% of the total freshwater resources is in the form of groundwater and it is about 35-50 times that of surface water supplies. Overuse of groundwater results in:

- Subsidence

- Lowering of water table
- Water logging

2) Surface water

Water coming through precipitation (rainfall, snow) when does not percolate down into the ground or does not return to the atmosphere as evaporation or transpiration loss, assumes the form of streams, lakes, ponds, wetlands or artificial reservoirs known as surface water. The surface water is largely used for irrigation, industrial use, public water supply, navigation etc. A country's economy is largely dependent upon its rivers. The problems arising out of water resources are floods, droughts.



Conflicts over water

1. Indispensability of water and its unequal distribution has often led to inter-state or international disputes. Issues related to sharing of river water have been largely affecting our farmers.
2. Water conflict has affected the Middle East- countries involved such as Sudan, Egypt, Turkey- it also affects countries who are water starved viz. Saudi Arabia, Kuwait, Syria, Israel and Jordan.

3. The Indus Water treaty-is a dispute between India and Pakistan.
4. The Cauvery water dispute- involves two major southern states of India viz. Tamil Nadu, Karnataka.
5. The Satluj-Yamuna link canal Dispute also involves two Northern states viz. Punjab and Haryana. Affected states also include UP, Rajasthan as well as Delhi.
6. In traditional water management, innovative arrangements ensure equitable distribution of water, which are democratically implemented. The ‘gram Sabha’s” approve these plans publicly.

While water disputes between states and nations often resume battle like situations, our traditional water managers in villages prove to be quite effective.

FLOODS AND DROUGHT

Water is a basic necessity for the survival of life on earth. Water cycle has helped in maintaining the quantity of water on the surface of earth. About 50 litres of water is needed per day per person in order to sustain a healthy life. There are many areas where people do not receive this basic quantity of water.

Areas that do not receive adequate amount of rainfall and have dry soil suffer from droughts. Whereas areas which receive heavy rainfall and have marshy soil generally get flooded. Floods and droughts are contrary concepts.

Causes and Effects of Floods

The amount of rainfall received by an area varies from one place to another depending on the location of the place. In some places it rains almost throughout the year whereas in other places it might rain for only a few days. India records most of its rainfall in the monsoon season. Rains are a big relief after the hot and sunny days of summers. The growth of crops is also dependent on the arrival of monsoons. However, excess rainfall is disadvantageous in many ways. Heavy rains lead to rise in the water level of rivers, seas and oceans. Water gets accumulated in the coastal areas which results in floods. These floods cause extensive damage to crops, domestic animals, property and human life. During floods, many animals get carried away by the force of water and eventually die.

Causes of Droughts and its Effects

The soil will continuously lose groundwater by the process of evaporation and transpiration. Since this water is not brought back to earth in the form of rains, the soil becomes very dry. The level of water in the ponds and rivers goes down and in some cases water bodies get dried up completely. Groundwater becomes scarce and this leads to droughts. In drought conditions it is very difficult to get food and fodder for the survival. Life gets difficult and many animals perish in such conditions.

REVIEW QUESTIONS

1. What are water resources?
2. Explain:
 - *Surface Water
 - *Ground Water

ENERGY RESOURCES

Energy resources are all forms of fuels used in the modern world, either for heating, generation of electrical energy, or for other forms of energy conversion processes. Energy resources can be roughly classified in three categories: renewable, fossil, and nuclear. Renewable energy resources are forms of energy that are naturally replenished on our planet. Examples of traditional renewable resources are hydropower and biomass (e.g., plant fuels such as wood traditionally have been used throughout history, mostly for heating). Modern renewable resources include wind, wave, tidal, solar, and geothermal.

Fossil energy resources are obtained from dead plant and animal deposits created over the long history of the planet. These resources are vast, but limited, and are not renewable. Until recently fossil fuels have provided for the majority of humanity's energy demands. These resources mainly include coal, oil, and natural gas.

Deposits of certain radioactive elements in Earth's crust can be classified as nuclear energy resources. These resources are used as fuel for nuclear fission-based power plants. The amount of these rare radioactive elements is limited on our planet and cannot be replenished. Over the years, there has been some research on fusion power but it is still not proven to be a feasible energy resource.



USES OF ALTERNATE ENERGY SOURCE:

There are many reasons to use alternative energy sources. One reason is to reduce pollutants and greenhouse gases. Alternative or renewable energy sources help to reduce the amount of toxins that are a result of traditional energy use. These alternative energy sources help protect against the harmful by-products of energy use and help to preserve many of the natural resources that we currently use as energy sources. There are many alternative energy sources: wind power, solar power, geothermal power, and hydroelectric power are some examples.

Growing Energy Needs

With increased speed of development in the developing nations energy needs are also increasing.

1. 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.
2. 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.

3. 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.
4. Energy resources are primarily divided into two categories viz. renewable and non-renewable sources.
5. Renewable energy resources must be preferred over the non-renewable resources.
6. It is a inevitable truth that now there is an urgent need of thinking in terms of alternative sources of energy which is also termed as non-conventional energy sources which include:
 - Solar energy needs equipment such as solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace and solar power plants.
 - Wind energy
 - Hydropower, Tidal energy, ocean thermal energy, geothermal energy, biomass, biogas, biofuels etc.

CASE STUDIES IN DENMARK

Denmark depended on large coal plants for its electricity needs. The Government policy led to development of onshore wind power, offshore wind power, combined heat and power and solar photovoltaic (PV) power. In Denmark solar resource is limited. In 2018, wind energy supplied 40.7%, solar PV 2.8%, fossil fuel 23.5%, biomass and waste cogeneration 17.8% and 15.3% from imports. Denmark approach is basically market-based. Vast majority of trade based on day ahead market lead to flexible generation and import from international connections. Denmark has taken the following steps for integration: (1) Strong transmission grids and interconnections. (2) International electricity markets – wholesale. (3) Flexible and controllable generation system. (4) Specialized forecasting and operational planning tools. (5) Well-known rules and

business models. Denmark has planned 100% renewable electricity by 2030 and 100% renewable energy by 2050.

CASE STUDIES IN INDIA

CEA (Central Electricity Authority) and IEA (International Energy Agency) have carried out detailed modelling of supply and demand on an hourly basis, and have come to the conclusion that renewable energy generation may have to be curtailed on some days (Table 5). The CEA report mentions that one limitation is coal plant operation at 55% of minimum load. With minimum load reduced to 40%, further absorption is possible. Another important point to note is that both CEA and IEA assume gas-based capacity at 25,000 MW (same as now). India has planned to increase share of gas in energy supply from 6% to 15%. Gas provides highly flexible source and gas capacity can safely aimed to be 40 GW. Gas-based generation can increase from 35 to 60 BU in 2029. This will allow full absorption of all solar and wind generation. Also, solar and wind system inverters themselves will be able to provide many grid functions.

CASE STUDIES IN GUJARAT

IEA (International Energy Agency) has given an interesting example for renewable energy absorption for Gujarat, using detailed modelling. In Gujarat 13% of energy generation is provided by wind and solar, with little curtailment at present. In 2030, Gujarat plans to have 44 GW of solar and wind energy in the state, and another 20 GW imported from other states. Renewable energy generation would be 40% and curtailment of power would be about 7%. IEA has suggested the following three steps. (i) Demand side response: Agriculture accounts for 20% of consumption, mainly during night hours. Agriculture feeder separation has been done in Gujarat. If agriculture is provided, energy during the daytime using solar curtailment

can be reduced to 3%. (ii) Flexible operation of coal plants: Reducing minimum load to 40% from 50% will allow more renewable energy absorption. (iii) Provision of 4000 MW of battery: This will allow for better renewable energy absorption. About 40% renewable energy generation on average and 100% on some days is possible in Gujarat.

REVIEW QUESTIONS

1. What is Energy Resources?
2. Use of alternative energy source?

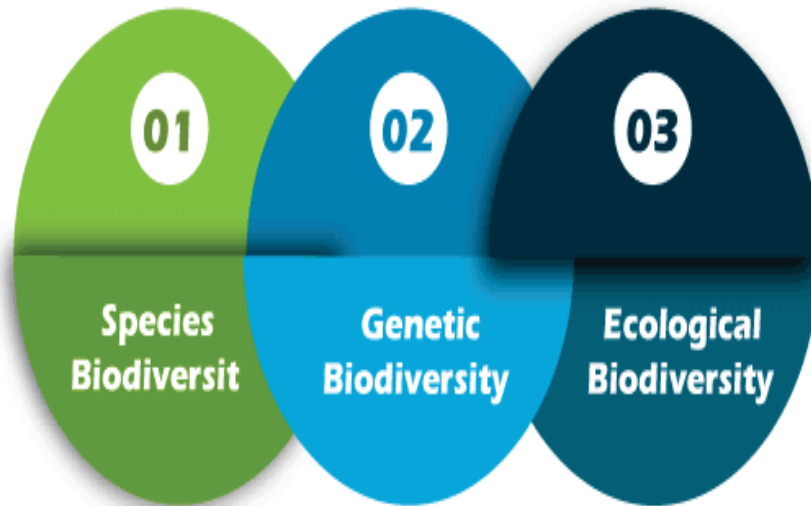
UNIT 4

BIODIVERSITY AND CONSERVATION

The term biodiversity refers to the variety of life on earth at all its levels, from genes to ecosystems, and the ecological and evolutionary processes that sustain it. Biodiversity describes the richness and variety of life on earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain. The term biodiversity was coined in 1985. It is important in natural as well as artificial ecosystems. It deals with nature's variety, the biosphere. It refers to variabilities among plants, animals and microorganism species. Biodiversity includes the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels.

Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Types of Biodiversity



1) Species Diversity

Species diversity refers to the variety of different types of species found in a particular area. It is biodiversity at the most basic level. It includes all the species ranging from plants to different microorganisms.

No two individuals of the same species are exactly similar i.e. humans show a lot of diversity among themselves.

Examples of species include blue whales, white-tailed deer, white pine trees, sunflowers, and microscopic bacteria that can't even be seen by the naked eye.

There are two constituents of species diversity:

- **Species richness:**

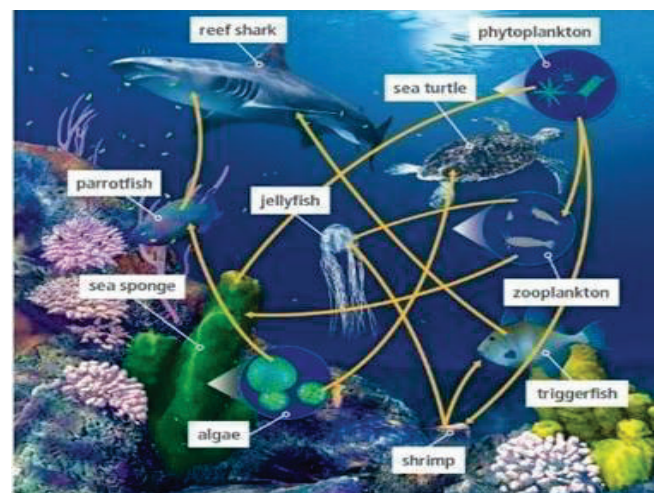
Number of different species present in an ecosystem. Tropical areas have greater species richness as the environment is conducive for a large number of species.

- **Species evenness:**

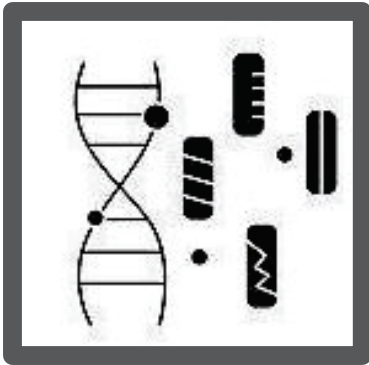
Relative abundance of individuals of each of those species. If the number of individuals within a species is fairly constant across communities, it is said to have a high evenness and if the number of individuals varies from species to species, it is said to have low evenness. High evenness leads to greater specific diversity.

Importance of Species Diversity

- More diverse ecosystem tends to be more productive. E.g., the ecosystem with a great variety of producer species will produce large biomass to support a greater variety of consumer species.
- Greater species richness and productivity makes an ecosystem more sustainable and stable.
- More diverse the ecosystem, greater is the ability to withstand environmental stresses like drought or invasive infestations.
- Healthy biodiversity has innumerable benefits like nutrients storage and recycling, soil formation and protection from erosion, absorption of harmful gases and climate stability.
- Diversity in large numbers helps in large scale interaction among organisms such as in the food web.
- In the nitrogen cycle, bacteria, plants have a crucial relationship, earthworms contribute to soil fertility.

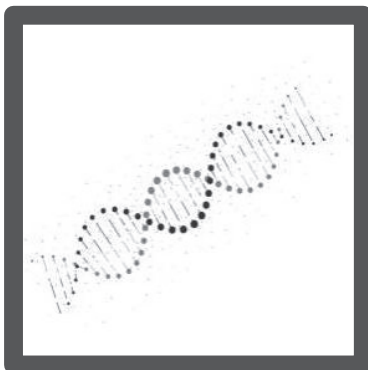


GENETIC DIVERSITY



Genetic diversity is defined as genetic variability present within species. “Genetic” means related to traits passed from parent to offspring, “Diversity” means having a range of different things.

Genetic diversity is the product of recombination of genetic material in the process of inheritance. It changes with time and space. Genetic diversity is critical for a population to adapt to changing environments



.Sexual reproduction is important in maintaining genetic diversity as it gives unique offspring by combining genes of parents. Mutation of genes, genetic drift and gene flow are also responsible for genetic diversity.

Importance of Genetic Diversity

- Genetic diversity gives rise to different physical attributes to the individual and capacity to adapt to stress, diseases and unfavourable environmental conditions.
- Environmental changes that are natural or due to human intervention, lead to the natural selection and survival of the fittest. Hence, due to genetic diversity, the varieties that are susceptible, die and the remaining varieties who can adapt to changes will survive.

- Genetic diversity reduces the recurrence of undesirable inherited traits.
- Genetic diversity is important for a healthy population by maintaining different varieties of genes that might be resistant to pests, diseases or other conditions.
- New varieties of plants can be grown by cross-breeding different genetic variants and produce plants with desirable traits like disease resistance, increased tolerance to stress.
- Genetic diversity ensures that at least there are some survivors of a species left.

Examples are different breeds of dogs. Dogs are selectively bred to get the desired traits, more than 50,000 varieties of rice and more than a thousand varieties of mangoes are found in India ,different varieties of rose flower, wheat and medicinal plant.

ECOLOGICAL DIVERSITY

Ecological biodiversity refers to the variations in the plant and animal species living together and connected by food chains and food webs.

Principles of Ecological Diversity

The following ecological principles describe the assumptions needed to plan actions for conserving biodiversity:

- Protection of species and species subdivisions will support biodiversity.
- Maintaining habitat is fundamental to conserve species.
- Large areas usually contain more species than smaller areas with similar habitat.

The two main areas where the effects of biodiversity on ecosystem function have been studied are the relationship

between diversity & productivity and the relationship between diversity & community stability.

Review Questions

Part – A

1. What is Biodiversity?
2. Importance of Species Diversity.
3. Difference between Genetic Diversity and Species Diversity.
4. List down the Impacts of Ecological diversity.
5. Explain the two constituents of Species Diversity?

Part – B

1. Explain Biodiversity with examples?
2. Describe the Levels of biological diversity.

BIOGEOGRAPHIC ZONES OF INDIA

Biogeography is the study of the distribution of species (biology), organisms, and ecosystems in geographic space and through geological time. There are ten biogeographic zones in India. India is a mega diverse country and a rich heritage of natural diversity. With only 2.4 per cent of the total land area of the world, India contributes 8 per cent to the known global biological diversity.

India ranks fourth in Asia and tenth in the world among the top 17 mega-diverse countries in the world. India harbours nearly 11% of the world's floral diversity comprising over 17500 documented flowering plants, 6200 endemic species, 7500 medicinal plants and 246 globally threatened species in only 2.4% of world's land area. It is also home to four biodiversity hot spots—Andaman & Nicobar Islands, Eastern Himalaya, Indo-Burma region, and the Western Ghats.

Biogeographic Region	%
Andaman and Nicobar Islands	0.3
Coastal Region	2.5
North East Region	5.2
Gangetic Plain	10.8
Deccan Plateau	42
Western Ghats	4
Semi-Arid Region	16.6

Indian Desert Zone	6.6
Himalayan Zone	6.4
Trans-Himalayan Region	5.6
Total	
*of total geographic area	100

BIODIVERSITY PATTERN IN SPECIES

1) Latitudinal gradient

This is the most well-defined and well-known pattern of biodiversity studies till date. According to this pattern, the species diversity follows a regular pattern as we move from the equator to the Polar Regions. The plant and animal diversity are observed to be maximum at the equator and it decreases as we move towards the poles. There might be an exception to a few species, but apart from that, it is a generally observed trend. We find species richness in plants and animals at the equator. India, located in the tropical regions, shows high species richness.

2) Species-Area relationships

Species-area relationships (SAR) refers to the relationship between the number of species of plants and animals and the size of a specific area of land. As one would expect, larger areas of land will usually contain more species of plants and animals compared to smaller areas of land. There are many factors that can impact and influence SAR, which include:

- **Habitat heterogeneity:** the variation of physical characteristics of a specific habitat, including weather, vegetation, and soil

- **Speciation:** the formation of a new species due to evolution; increased speciation leads to more species in a specific area of land
- **Fragmentation:** dividing a larger habitat into several smaller habitats that are isolated from one another
- **Dispersal:** the movement of members of a species to a different location from where they were originated

Global biodiversity hotspots

According to Conservation International, a region must fulfil the following two criteria to qualify as a hotspot:

- The region should have at least 1500 species of vascular plants i.e., it should have a high degree of endemism.
- It must contain 30% (or less) of its original habitat, i.e. it must be threatened. There are major four biodiversity hotspots in India:

1) The Himalayas

The Himalayas (overall) comprises North-East India, Bhutan, Central and Eastern parts of Nepal. This region (NE Himalayas) holds a record of having 163 endangered species which includes the Wild Asian Water Buffalo, One-horned Rhino; and as many as 10,000 plant species, of which 3160 are endemic. This mountain range covers nearly 750,000 kms.

2) Indo – Burma Region

In the last 12 years, 6 large mammal species have been discovered in this region: the Large-antlered Muntjac, the Annamite Muntjac, the Grey-shanked Douc, the Annamite Striped Rabbit, the Leaf Deer, and the Saola.

This hotspot is also known for the endemic freshwater turtle species, most of which are threatened with extinction, due to over-harvesting and extensive habitat loss.

3) The Western Ghats

The Western Ghats are present along the western edge of peninsular India and covers most of the deciduous forests and rain forests. As per UNESCO, it is home to at least 325 globally threatened flora, fauna, bird, amphibian, reptile and fish species. The region is also known for the globally threatened flora and fauna represented by 229 plant species, 31 mammal species, 15 bird species, 43 amphibian species, 5 reptile species and 1 fish species.

4)Sundaland

The Sundaland hotspot lies in South-East Asia and covers Singapore, Thailand, Indonesia, Brunei, and Malaysia. In the year 2013, the Sundaland was declared as a World Biosphere Reserve by the United Nations. This region is famous for its rich terrestrial and marine ecosystem. Sundaland is one of the biologically richest hotspots in the world which comprises 25,000 species of vascular plants, of which 15,000 are found only in this region.

India as a Mega Diversity Region

Mega diversity refers to a country's ability to exhibit a high level of biodiversity. A biologically diverse nation has at least 5,000 plant species and must be bordered by marine ecosystems.

The term 'mega' represent 'large'. Thus, mega diversity means a large number of species are present in the ecosystem. As India is rich in the diversity of animals and plants, India is called a mega diversity centre.

Endangered and Endemic Species of India

Endangered species are animals or plants which exist in very less number and if not conserved properly, will extinct. Endemic Species are plants or animals exist in some particular regions and nowhere in the world. Unless conserved, these also will disappear from earth.

According to the International Union for Conservation of Nature, “India accounts for 7-8% of all recorded species, including over 45,000 species of plants and 91,000 species of animals. But with the rapid loss of biodiversity, many species are becoming extinct or at risk of becoming critically endangered. The species that are at risk of extinction due to the sudden decrease in their population and habitat are known as endangered species. The top 5 endangered species (Flora and Fauna) in India are listed in the table below:

Top 5 Endangered Species of India	
Endangered Animal Species	Endangered Plant Species
The Royal Bengal Tiger	Ebony tree
The Great Asiatic Lion	Indian Mallow
The Snow Leopard	Malabar Lily
Nilgiri Tahr	Assam Catkin Yew
Indian Rhino	Milkwort

Review Questions

Part – A

1. Explain Gangetic Plain and Western Ghats?
2. Discuss about biodiversity patterns in Species.
3. Describe Global Biodiversity Hotspots.
4. List out some of the Endangered and Endemic Species in India.

Part – B

1. Explain the Biogeographic zones of India?
2. Why India is called as Mega Diversity Region?

THREATS TO BIODIVERSITY

The core threat to biodiversity on the planet, and therefore a threat to human welfare, is the combination of human population growth and resource exploitation. The human population requires resources to survive and grow, and those resources are being removed unsustainably from the environment. The three greatest proximate threats to biodiversity are habitat loss, over harvesting, and introduction of exotic species. The first two of these are a direct result of human population growth and resource use. The third results from increased mobility and trade. A fourth major cause of extinction, anthropogenic climate change, has not had a large impact, but it is predicted to become significant during this century.

Global climate change is also a consequence of human population needs for energy and the use of fossil fuels to meet those needs. Environmental issues, such as toxic pollution, have specific targeted effects on species, but they are not generally seen as threats at the magnitude of the others.

What are threats to Biodiversity?

1. Habitat Loss and Degradation

Biodiversity is threatened when there is significant habitat loss or degradation. This happens when an area that was once used as a habitat is no longer inhabited by nature. Things like deforestation, mining, agriculture and industrial activities often remove crucial habitat space for wildlife and plants. However, natural events could also cause habitat degradation. This would include events such as hurricanes, volcanic eruptions and forest fires.

2. Invasive Species

Another reason for the loss of biodiversity is the introduction of invasive species. Invasive species include any plants or animals that are unnatural or non-native to an ecosystem. These species threaten and often outcompete the plants and animals already present in a habitat. For example, the Emerald Ash Borer has wiped out a considerable portion of the ash trees in North America. It was likely introduced through cargo materials and has created a loss in biodiversity.

3. Pollution

Whether the pollution is in the water, air or land, any form of pollution is a threat to biodiversity. Toxic synthetic chemicals and products enter ecosystems, which has led to the extinction of animal and plant species. Even natural substances can become pollution if they're overabundant in a particular area. Plastic pollutants have gone deep into the oceans and have even been found at microscopic levels on Mount Everest and in the human digestive system.

4. Climate Change

The increase in global temperatures has had significant effects on the environment. Seasons are coming earlier or later than expected, which can leave animals struggling to find resources to survive and adapt. Additionally, climate change has led to a rise in sea levels and a decreasing amount of sea ice, which has affected both animals in the sea and on land. As climate and temperatures continue to change, the threats to biodiversity will only increase.

5. Over exploitation of Natural Resources

Activities such as targeted hunting, fishing and gathering of animals, plants and other natural resources threaten biodiversity. The loss of large populations of animals

or plants in a short amount of time can cause a rippling effect on the other wildlife in that region. For example, if a primary predator is over-fished, there will be nothing to keep prey populations in check. Furthermore, overexploitation of non-renewable resources will affect daily human life.

6. Human Activity and Population

The increase in the population of humans has had a significant impact on biodiversity. Biodiversity is likely to decrease because of the increased needs (food, water and shelter) as well as urbanization and development. People will need places to live, work and play, so regions once filled with forests and diversity will become concrete jungles, forcing animals to leave their habitats and depleting the area of plants.

Major Threats to Biodiversity

1. Habitat Loss:

Habitat loss is probably the greatest threat to the variety of life on this planet today. Habitat loss poses the greatest threat to species. The world's forests, swamps, plains, lakes, and other habitats continue to disappear as they are harvested for human consumption and cleared to make way for agriculture, housing, roads, pipelines and the other hallmarks of industrial development. Without a strong plan to create terrestrial and marine protected areas important ecological habitats will continue to be lost.

2. Poaching of Wildlife:

Poaching, in law, the illegal shooting, trapping, or taking of game, fish, or plants from private property or from a place where such practices are specially reserved or forbidden. Poaching is a major existential threat to numerous wild organisms worldwide and is an important contributor to biodiversity loss.

3. Man - Wildlife Conflicts

Human-wildlife conflict is when encounters between humans and wildlife lead to negative results, such as loss of property, livelihoods, and even life. Defensive and retaliatory killing may eventually drive these species to extinction.

Human-wildlife conflict occurs when the needs and behaviour of wildlife impact negatively on humans or when humans negatively affect the needs of wildlife. The major causes of Man-Wildlife conflicts are as follows,

1. Agricultural Expansion
2. Human Settlement
3. Overgrazing by Livestock
4. Deforestation
5. Illegal grass collection and poaching

4. Biological Invasions

Biological invasions are a major force of change, affecting many dimensions of life on Earth. Invasions result when species colonize new geographic regions, which are isolated from existing populations.

Biological invasion has been defined as the process by which an organism is introduced to and establishes a sustainable population in a region beyond its native geographical range. The spread of an organism or species into an area formerly free of it, typically with detrimental effects such as the displacement or extinction of native species, destabilization of the invaded ecosystem, etc., are instances of this.

GLOBAL CONSEQUENCES AND CONTROL STRATEGIES OF BIOLOGICAL INVASION

Biological invasion is a worldwide ecological phenomenon, but its mechanism is still not very clear. Invasive species give impacts on native species and ecosystems through competitions, predation, changing habitats and dispersing diseases. They pose an increasing threat to the composition and structure of natural communities across the globe. Biological invasion has been greatly damaging the ecological and evolutionary integrity of natural ecosystems, which will weaken the functions of the ecosystems and frequently cause natural disasters. A better understanding of the causes, patterns, predictability, consequences, and management options associated with this threat to biodiversity is necessary to guide managers, policy makers, researchers, and general public.

Control Measures:

- Biological invasion largely decreases global biodiversity, which will threaten the survival and development of our descendants. Three steps are used in prevention and control of biological invasions.
- Comprehensive quarantine is the most effective way to prevent exotic invasion by accident.
- Ecological evaluation and monitoring is helpful to avoid disasters from species introduction.
- Physical methods, chemical approaches and biological controls are used to eradicate and control the spread of invaded species.

Before biological controls are chosen, risk analysis of controlling organism is needed. Ideally, there should be both preeradication assessment to tailor removal to avoid unwanted

ecological effects and post-removal assessment of eradication effects on both the target organism and the invaded ecosystem.

REVIEW QUESTIONS

PART A

1. What are the threats to Biodiversity?
2. What are the major causes of Man wildlife conflicts in India?
3. Explain Modern poaching.
- 4.. Write Global consequences and control strategies of biological invasion.

CONSERVATION OF BIODIVERSITY

Conservation of biodiversity is considered as key component for administration of natural assets. Biodiversity is an all-encompassing concept that describes the magnitude of ecological diversity. Biodiversity is the wide range of life associated with different types of frameworks for biodiversity. The warnings to biodiversity involve habitat fragmentation, stressing the already squeezed natural resources, deforestation; annexation of invasive species and climate alternation.

Environmentalists and the public have become increasingly aware of these threats, preventive ecosystem protection has become an essential component of NRM. Decision making relies on facts leading to strong quality of evidence, the restriction of specific activities and knowledge and control criteria. Numerical evidence is required before making the policy of safety measure. Such activities should be banned if the imminent threat of operations is deemed a serious and permanent risk.

Conservation of biodiversity is protection, upliftment and scientific management of biodiversity so as to maintain it at its threshold level and derive sustainable benefits for the present and future generation.

Biodiversity conservation has three main objectives:

1. To preserve the diversity of species.
2. Sustainable utilization of species and ecosystem.
3. To maintain life-supporting systems and essential ecological processes.

BIODIVERSITY AND ITS CONSERVATION METHODS

Biodiversity refers to the variability of life on earth. It can be conserved in the following ways:

1) In-situ Conservation

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected.

Certain protected areas where in-situ conservation takes place include national parks, wildlife sanctuaries and biosphere reserves.

- in-situ conservation (**National Parks**)

These are small reserves maintained by the government. Its boundaries are well demarcated and human activities such as grazing, forestry, habitat and cultivation are prohibited. For eg, Kanha National Park, and Bandipur National Park.

- in-situ conservation (**Wildlife Sanctuaries**)

These are the regions where only wild animals are found. Human activities such as timber harvesting, cultivation, collection of woods and other forest products are allowed here as long as they do not interfere with the conservation project. Also, tourists visit these places for recreation.

- in-situ conservation (**Biosphere Reserves**)

Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected. Tourist and research activities are permitted here.

Advantages.

1. It is a cost-effective and convenient method of conserving biodiversity.
2. A large number of living organisms can be conserved simultaneously.

Since the organisms are in a natural ecosystem, they can evolve better and can easily adjust to different environmental conditions.

2) Ex-situ Conservation

Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks, etc. There is less competition for food, water and space among the organisms.

Advantages:

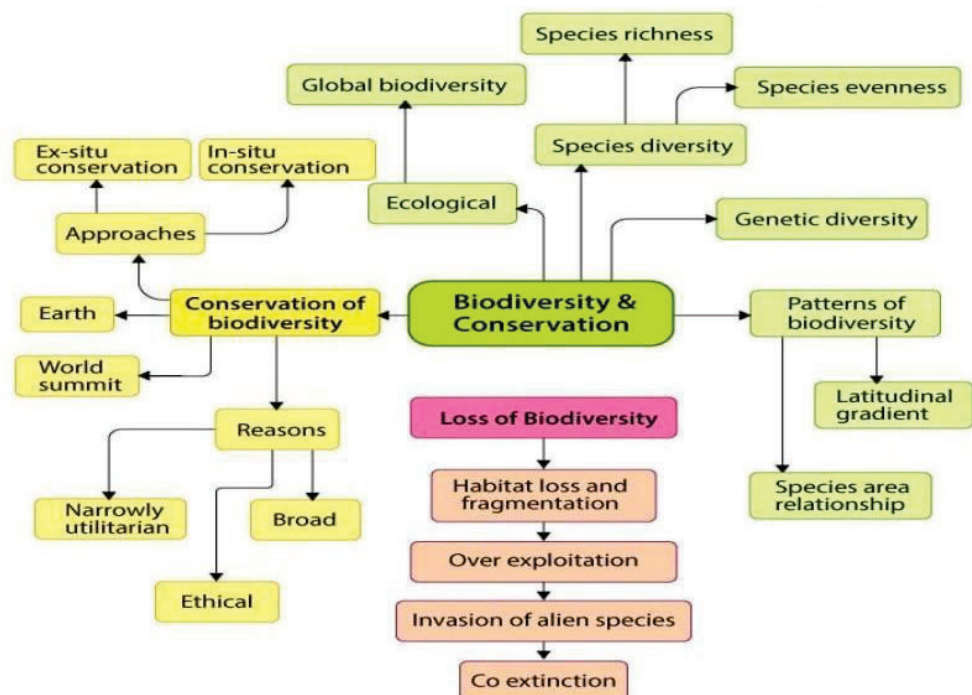
- The animals are provided with a longer time and breeding activity.
- The species bred in captivity can be reintroduced in the wild.
- Genetic techniques can be used for the preservation of endangered species.

STRATEGIES FOR BIODIVERSITY CONSERVATION

- All the varieties of food, timber plants, livestock, microbes and agricultural animals should be conserved.
- All the economically important organisms should be identified and conserved.
- Unique ecosystems should be preserved first.
- The resources should be utilized efficiently.

- Poaching and hunting of wild animals should be prevented.
- The reserves and protected areas should be developed carefully.
- The levels of pollutants should be reduced in the environment.
- Deforestation should be strictly prohibited.
- Environmental laws should be followed strictly.
- The useful and endangered species of plants and animals should be conserved in their natural as well as artificial habitats.
- Public awareness should be created regarding biodiversity conservation and its importance.

Biodiversity and Conservation flow chart



REVIEW QUESTIONS

Part – A

1. What is Biodiversity?
2. List out the Strategies of biodiversity conservation.
3. Advantages of In-situ and Ex-situ.

Part – B

1. Explain conservation methods of Biodiversity
2. Discuss In-situ conservation with examples.

ECOSYSTEM AND BIODIVERSITY SERVICES: ECOLOGICAL, ECONOMIC, SOCIAL, ETHICAL, AESTHETIC AND INFORMATIONAL VALUE

Ecosystem refers to the system resulting from the interaction of all the living and non-living factors of the Environment. There are many examples of ecosystems - a pond, a forest, an estuary, a grassland.

Biodiversity is the biological variety and variability of life on Earth. It includes diversity within and among species and ecosystems. Biodiversity is a measure of variation at the genetic, species, and ecosystem level.

ECOSYSTEM AND BIODIVERSITY SERVICES

1) Ecological Services

Ecological life support—biodiversity provides functioning ecosystems that supply oxygen, clean air and water, pollination of plants, pest control, wastewater treatment and many ecosystem services. Ecosystem services, such as

- Protection of water resources (Hydrological cycle)
- Soil formation and protection (soil conservation)
- Nutrient storage and recycling (biogeochemical cycle)
- Pollution breakdown and absorption (purifying air, water and soil)
- Contribution to climate stability (regulation of weather and climate)
- Maintenance of ecosystems stability
- Anthropogenic carbon shrinkage and carbon sequestration
- Recovery from unpredictable events

2) Economic Services

Foods

- Food crops, livestock, forestry, fish, fruits, honey, etc. exist because of the ecological services of pollinators.
- Fish provide billions of people with essential animal protein.
- Thousands of species of plants have been cultivated for consumption throughout human history
- Meat from native wildlife contributes to food and livelihoods in many countries.

Medication

Many wild plant species have been used for medicinal purposes from time immemorial. For example, quinine comes from cinchona tree (used to treat malaria), digitoxin from the foxglove plant (to treat chronic heart trouble) and morphine from the poppy plant (pain relief), Aspirin was originally made from willow tree bark, and Penicillin and tetracycline, as well as other antibiotics, are derived from microorganisms. Over 70 % of the promising anti-cancer drugs come from plants in the tropical rainforests. It is estimated that of the 250,000 known plant species, only 5,000 have been researched for possible medical applications.

Industry

- Wood: For shelter, warmth, furniture and infrastructures
- Paper: from soft woods and grass
- Textile: Cotton and fibres for clothing
- Energy: Biodiversity may be a source of energy (such as biomass)
- Agro-based industry: Supplies from animal origin are wool, silk, fur, leather, lubricants and waxes

- Animal husbandry: Animals may also be used as a mode of transportation.
- Tourism and recreation: Biodiversity is a source of economical wealth for many areas, such as many parks and forests, where wild plants and animals are a source of beauty and joy for many people.
- Other industrial products are oils, lubricants, perfumes, fragrances, dyes, paper, waxes, rubber, latex, resins, poisons and cork can all be derived from various plant species.

3) Aesthetic Value

- Stretches of barren lands with no signs of visible life is not a pleasant sight
- The pleasure of enjoying wildlife's beauty
- Eco-tourism is based on the aesthetic value of biodiversity
- Eco-tourism is estimated to generate about 12 billion dollars of revenue annually.

4) Ethical values

It is also known as existence value. It involves ethical issues like "all life must be preserved" and the concept of "Live and let live" If humans consider species have a right to exist, they cannot cause voluntarily their extinction. Besides, biodiversity is also part of many cultures of spiritual heritage.

5) Scientific Values

- Studying about research on plants and animals
- Each species can give scientists some clue as to how life evolved and will continue to evolve on Earth
- Biodiversity helps scientists understand how life functions and the role of each species in sustaining ecosystems.

- Search for their possible use of medication
 - Integrated pest management
- 6) **Social values:** Values associated with the social life, customs, religion and psycho-spiritual aspects of people. Many of the plants are considered holy and sacred in our country (Tulsi, Peepal, Mango). Many animals like cows, snakes, bulls and peacocks also have a significant place in our psycho-spiritual arena and thus hold special social importance

REVIEW QUESTIONS

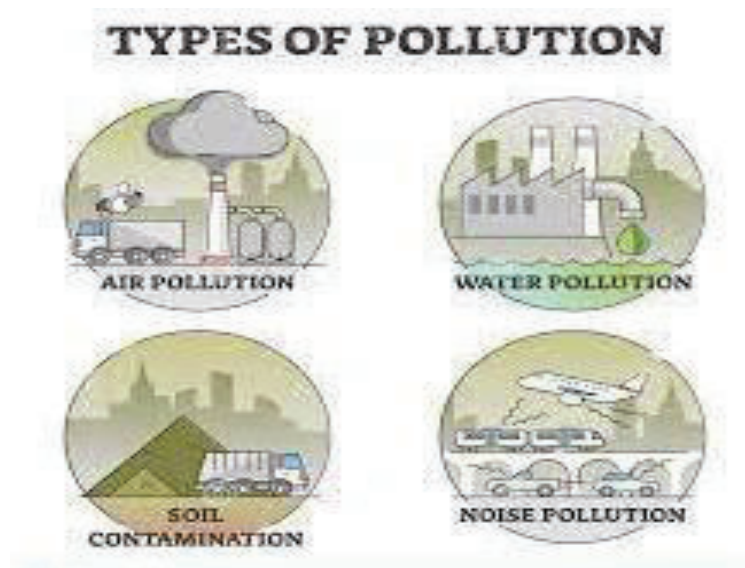
1. Explain about various Ecosystem and bio diversity services

UNIT 5

ENVIRONMENTAL POLLUTION

Pollution is the introduction of harmful materials into the environment. These harmful materials are called pollutants. The term "pollution" refers to any substance that negatively impacts the environment or organisms that live within the affected environment.

Pollution, also called environmental pollution, the addition of any substance (solid, liquid, or gas) or any form of energy (such as heat, sound, or radioactivity) to the environment at a rate faster than it can be dispersed, diluted, decomposed, recycled, or stored in some harmless form. The major kinds of pollution, usually classified by environment, are air pollution, water pollution, and land pollution. Modern society is also concerned about specific types of pollutions, such as noise pollution, light pollution, and plastic pollution. Pollution of all kinds can have negative effects on the environment and wildlife and often impacts human health and well-being



1) AIR POLLUTION

Air pollution is of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Most of the global population (99%) breathe air that exceeds WHO guideline limits and contains high levels of pollutants, with low- and middle-income countries suffering from the highest exposures. of contamination. There two types of air pollution are

INDOOR AIR POLLUTION

Indoor air pollution is the degradation of indoor air quality by harmful chemicals and other materials; it can be up to 10 times worse than outdoor air pollution. This is because contained areas enable potential pollutants to build up more than open spaces.

EXAMPLE – wood smoke, cook stoves, firecrackers.

OUTDOOR AIR POLLUTION

Outdoor air is often referred to as ambient air. The common sources of outdoor air pollution are emissions caused by combustion processes from motor vehicles, solid fuel burning and industry. Outdoor air pollution is a complex mixture originating from different natural and anthropogenic sources and consisting of particles, chemicals and biogenic substances with well-known health effects.

EXAMPLE – Industrial emission, Wildfire, Transportation

Effects of air pollution

- Increased risk of respiratory illness and cardiovascular problems
- Increased risk of skin diseases and cancer
- Global warming
- Acid rain

- Ozone depletion
- Hazards to wildlife
- Irritation to eyes, nose, throat and fatigue

Control measures

- Choose a cleaner commute - share a ride to work or use public transportation.
- Combine errands and reduce trips. Walk to errands when possible.
- Avoid excessive idling of your automobile.
- Refuel your car in the evening when it's cooler.
- Conserve electricity and set air conditioners not lower than 78 degrees
- Defer lawn and gardening chores that use gasoline-powered equipment or wittily evenings

2) WATER POLLUTION

Water pollution is the addition of substances or energy forms that directly or indirectly alter the nature of the water body in such a manner that negatively affects its legitimate uses. Therefore, water pollution is associated with concepts attributed to humans, namely the negative alterations and the uses of the water body. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants. Due to these contaminants it either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its biotic communities, such as fish.

Water pollution is the contamination of water sources by substances which make the water unusable for drinking, cooking, cleaning, swimming, and other activities. Pollutants include chemicals, trash, bacteria, and parasites.

Effects of water pollution

- ☐ Water pollution drastically affects human health; in fact, it can kill. In 2015 alone, a study revealed that waterborne illnesses caused 1.8 million deaths worldwide.
- ☐ It can cause contamination of drinking water – thereby contributing to waterborne illnesses. Water pollution also affects the ecosystem –
- ☐ It can cause a phenomenon called eutrophication. This can cause fish and other aquatic organisms to die.
- ☐ Toxic elements dissolved in water can make their way to humans through fish or other aquatic organisms.
- ☐ Water pollution also leaves chemicals into the soil that may impact the growth of plants or other food crops.

Control measures

- ☐ Dispose of toxic chemicals properly.
- ☐ Do not pour fat and grease down the drain.
- ☐ Use phosphate-free detergent and dish cleaner.
- ☐ Check our Sump Pump or Cellar Drain.
- ☐ Dispose of medical waste properly.
- ☐ Eat more Organic food.

3) LAND POLLUTION (OR) SOIL POLLUTION

Land pollution refers to the deterioration of the earth's land surfaces, at and below ground level. The cause is the accumulation of solid and liquid waste materials that contaminate groundwater and soil. These waste materials are often referred to as municipal solid waste (MSW), which includes both hazardous and non-hazardous waste. When waste

is deposited onto an area of land, the permeability of the soil formations below the waste can increase or reduce the risk of land pollution. The higher the permeability of the soil, the more likely that land pollution will occur.

The permeability of soil formations underlying a waste-disposal site is of great importance with regard to land pollution. The greater the permeability, the greater the risks from land pollution.

Effects of land pollution

Climate change - Land contamination which is caused by mining, farming and factories, may allow harmful chemicals to enter the soil and water. These chemicals have the potential to kill animals and plants, destroying the food chain. Landfills emit methane, a greenhouse gas that contributes to global warming.

Acid rain - Forests, especially those at higher elevations, are also harmed by acid rain and fog. Acid deposits deplete vital nutrients like calcium and allow aluminium to be released into the soil, making it difficult for trees to absorb water. Acids also damage the leaves and needles of trees.

Deterioration of fields - A chain reaction occurs as a result of soil contamination. It alters soil biodiversity, decreases soil organic matter, and reduces soil's filtering ability. It also contaminates water contained in the soil and groundwater, resulting in nutrient imbalances in the soil.

Respiratory health problems - Air pollution can irritate airways, causes shortness of breath, coughing, wheezing, asthma attacks and chest pain. Lung cancer, heart attacks, strokes, and, in the worst-case scenario, premature death are all risks associated with air pollution exposure.

Control measures

- ☐ Recycle waste materials.
- ☐ Buy organics products, especially organic cleaners, pesticides, insecticides and fertilizers.
- ☐ Avoid littering and take initiative to inform others about the harmful effects of littering.
- ☐ Improve fertility of the land by reforesting

4) NOISE POLLUTION

Noise pollution is considered to be any unwanted or disturbing sound that affects the health and well-being of humans and other organisms. Sound is measured in decibels. High noise levels can contribute to cardiovascular effects in humans and an increased incidence of coronary artery disease. In animals, noise can increase the risk of death by altering predator or prey detection and avoidance, interfere with reproduction and navigation, and contribute to permanent hearing loss.

Effects of noise pollution

- High blood pressure and Hearing loss
- May affect the circadian rhythm (sleep cycles)
- Impair cognitive functions
- Irritability, high stress.
- May interfere with navigation
- Also affects the reproductive behaviour
- Unusual animal behaviour

Control measures

- Running TV and Radio at low volume
- Use less Horns while driving
- We should plant more trees.

- Use loudspeakers at low volume and not play music too loud during parties
- Stop bursting crackers

5) NUCLEAR HAZARDS

Radioactive (nuclear) pollution is a special form of physical pollution related to all major life supporting systems - air, water and soil. Exposure to very high levels of radiation, such as being close to an atomic blast, can cause acute health effects such as skin burns and acute radiation syndrome ("radiation sickness")

Effects of nuclear hazards

Exposure to very high levels of radiation, such as being close to an atomic blast, can cause acute health effects such as skin burns and acute radiation syndrome ("radiation sickness"). It can also result in long-term health effects such as cancer and cardiovascular disease.

SOLID WASTE MANAGEMENT:

The term solid waste management mainly refers to the complete process of collecting, treating and disposing of solid wastes. In the waste management process, the wastes are collected from different sources and are disposed of. This process includes collection, transportation, treatment, analysis and disposal of waste.

Sources of Solid Wastes

- Solid domestic garbage.
- Solid waste material from various industries.
- Solid agricultural waste.
- Plastics, glass, metals, e-waste, etc.

- Medical waste, Construction waste and sewage sludge



SOLID WASTE MANAGEMENT

Methods of solid waste disposal and management:

- Solid waste open burning.
- Sea dumping process.
- Solid wastes sanitary landfills.
- Incineration method.
- Composting process.
- Disposal by Ploughing into the fields.
- Disposal by hog feeding.
- Salvaging procedure.

Control Measures of Urban and Industrial Wastes

Indiscriminate disposal of solid wastes, especially hazardous wastes causes adverse environmental effects. The main objective of solid waste management is to minimise these adverse effects before it becomes too difficult to rectify in the future. It is a manifold task which involves

i) Collection of Solid Wastes:

Collection includes all the activities associated with the gathering of solid wastes and the hauling of the wastes collected to the location from where the collection vehicle will ultimately transport it to the site of disposal. There are three basic methods of collection.

- **Community storage point:** The municipal refuse is taken to fixed storage bins and stored till the waste collection agency collects it daily for disposal in a vehicle.
- **Kerbside Collection:** In advance of the collection time, the refuse is brought in containers and placed on the footway from where it is collected by the waste collection agency.
- **Block Collection:** Individuals bring the waste in containers and hand it over to the collection staff who empties it into the waiting vehicle and returns the container to the individuals.

ii) Disposal of Solid Wastes:

Before the solid waste is ultimately disposed of it is processed in order to improve the efficiency of the solid waste disposal system and to recover usable resources out of the solid wastes. The processing techniques such as compaction i.e. mechanical volume reduction or incineration i.e. thermal volume reduction and manual component separation i.e.

manual sorting of the waste are employed to increase the efficiency of solid waste management. The commonly used methods of disposal are

- **Salvage or Manual Component Separation:** Before ultimate disposal, the manual separation of solid waste components is accomplished to achieve the recovery and reuse of materials. Cardboard, newsprint, high quality paper, glass, metals, wood and aluminium cans etc. are manually sorted out or salvaged either for recycling or for resale.
- **Compaction or Mechanical Volume Reduction:** After separation of reusable or disposable articles, compactors are used to compress the waste materials directly into large containers or to form bales that can be later placed in large containers. Compaction increases the useful life of landfills.
- **Incineration or Thermal Volume Reduction:** Highly combustible wastes like plastics, cardboard, paper, rubber and combustible wastes like cartons, wood scrap, floor sweepings, food wastes etc. are subjected to incineration i.e. burning at very high temperatures. Incineration results in air pollution and so proper control equipment needs to be installed to avoid contamination of environment. In order to make this method economical, the heat generated during incineration is usefully utilised by generating steam or by putting a waste heat boiler on the incinerator thereby partly recovering the cost of waste collection and disposal.
- **Open Dumping:** Open dumping of solid wastes is done in low lying areas and outskirts of the towns and cities. Being comparatively cheaper, this method of disposal is used extensively in India.

- **Sanitary Land filling or Controlled Tipping:** Sanitary land filling involves the disposal of municipal wastes on or in the upper layers of the earth's mantle especially in degraded areas in need of restoration. In land filling, the solid wastes are compacted and spread in thin layers each layer being uniformly covered by a layer of soil. The final layer is covered by a final cover of about one meter of earth to prevent rodents from burrowing into the refuse and scattering. This is a biological method of waste treatment and bacterial refuse digestion results in decomposition products like CO_2 , CH_4 , NH_3 , H_2S and H_2O which can be harnessed as renewable sources of energy. This method does not cause environmental damages by creating nuisances or health hazards as the refuse is covered and prevents breeding of pests and disease vectors. Besides there is no danger of air pollution resulting from burning and no water pollution provided precaution is taken to avoid leachates of refuse from contaminating the surface or underground water sources.
- **Pyrolysis or Destructive Distillation:** In this disposal method, the solid wastes are heated under anaerobic conditions (i.e., burning without oxygen). The organic components of the solid wastes split up into gaseous liquid and gaseous fractions (CO , CO_2 , CH_4 , tar, charred carbon). Unlike the highly exothermic process of combustion, pyrolysis is a highly endothermic process and that is why it is also called destructive distillation.
- **Land farming:** In this waste disposal method, the biodegradable industrial wastes are treated by the biological, physical and chemical processes occurring in the surface of the soil. The organic wastes are either applied on top of the land or injected below the soil

surface with suitable equipment, where they undergo bacterial and chemical decomposition. At frequent intervals, the land farming sites can be reused without any adverse effects provided the land farming site is properly managed.

- **Composting or Biodegradation:** Bacterial decomposition of the organic components of the municipal solid wastes result in formation of humus or compost and the process is known as composting. In this process a compost pile is constructed by making alternate layers of organic matter and soil (source of micro-organisms). Some fertilizer and water is periodically added to the compost pile to stimulate microbial (bacteria and fungi) action and to maintain the necessary moisture content (55%). Periodically, the refuse is turned over to allow aeration i.e., penetration of oxygen to all parts of the organic refuse to facilitate aerobic bacterial decomposition. It takes nearly a month for composting to be complete. Large waste products such as machinery, old furniture, abandoned vehicles etc. are required to be reduced in size in order to become capable of being handled by pulverizers. This reduction in size is usually achieved by using impact crushers or hydraulic shears.

iii) Waste Utilisation:

Waste utilisation directly or indirectly contributes to economic development. Unused solid wastes create environmental hazards by spreading diseases and causing air and water pollution. Waste utilisation helps in conservation of natural resources. Waste utilisation helps to generate many useful products which are the basic necessities of life.

Resource recovery or waste utilisation is achieved by three techniques:

1. Reuse i.e., a given material has multiple uses.
2. Reclamation i.e., a component of the waste is recovered for use in a manner different from its original use.
3. Recycling i.e., isolating the material from which a given product was made and reintroducing it into the production cycle for production of the same product.

POLLUTION CASE STUDIES

- Sanitation in Ratlam: In a landmark judgement in 1980, the Supreme Court explicitly recognised the impact of a deteriorating urban environment on the poor. It linked basic public health facilities to human rights and compelled the municipality to provide proper sanitation and drainage. However, according to numerous reports, little has changed in Ratlam today.
- Doon valley quarrying: In 1987, the Rural Litigation and Entitlement Kendra, on the behalf of residents of the Doon valley, filed a case in the Supreme Court against limestone quarrying. This case was the first requiring the Supreme Court to balance environmental and ecological integrity against industrial demands on forest resources. The courts directed the authorities to stop quarrying in the Mussoorie hills, but today, mining continues unchecked in the interior valleys.
- Gas leak in Shriram factory: In the historic case of the oleum gas leak from the Shriram Food and Fertiliser factory in Delhi, in 1986, the Supreme Court ordered the management to pay compensation to the victims of the gas leak. The "absolute liability" of a hazardous chemical manufacturer to give compensation to all those affected by an accident was introduced in this case and it was the first time compensation was paid to victims.

- **Construction in Silent Valley:** In 1980, the Kerala High Court threw out a writ filed by the Society for the Protection of the Silent Valley seeking a ban on construction of a hydro-electric project in the valley. However, despite an unfavourable judgement, active lobbying and grassroots action by environmentalists stopped the project.
- **Polluting the Ganga:** In 1985, activist-advocate M C Mehta filed a writ petition in the Supreme Court to highlight the pollution of the Ganga by industries and municipalities located on its banks. In a historic judgement in 1987, the court ordered the closure of a number of polluting tanneries near Kanpur. Justice E S Venkataramiah, in his judgement, observed: "Just like an industry which cannot pay minimum wages to its workers cannot be allowed to exist, a tannery which cannot set up a primary treatment plant cannot be permitted to continue to be in existence."
- **Pollution in Bichhri:** Effluents from an H-acid factory in Bichhri village in Rajasthan has polluted the ground water of almost 60 wells, destroying crops and orchards. A case was filed in the Supreme Court by the Indian Council for Enviro-Legal Action in October 1989. Despite court orders in March 1990 to remove the sludge from the factory, not only does the sludge still pollute Bichhri's drinking water, but no compensation has been paid to the residents either.
- **Mining in Sariska:** A writ petition was filed in the Supreme Court in 1991 by the Tarun Bharat Sangh to stop mining in the Sariska wildlife sanctuary. The court banned mining in the sanctuary, but mining continues, nevertheless.

REVIEW QUESTIONS:

1. What is environmental pollution?
2. What are the types of pollutions?
3. Define air pollution and effects
4. What are the effects of land pollution?
5. What are the effects of water pollution?
6. What are the Control measures of land pollution?
7. Define nuclear hazard
8. Mention different types of disposals of solid waste.
9. Mention the commonly used method of disposal

UNIT-6

ENVIRONMENTAL POLICIES AND PRACTICES

CLIMATE CHANGE

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas.

Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures.

Examples of greenhouse gas emissions that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example. Clearing land and forests can also release carbon dioxide. Landfills for garbage are a major source of methane emissions. Energy, industry, transport, buildings, agriculture and land use are among the main emitters.

Causes of climate changes:

1) Generating power

Generating electricity and heat by burning fossil fuels causes a large chunk of global emissions. Most electricity is still generated by burning coal, oil, or gas, which produces carbon dioxide and nitrous oxide – powerful greenhouse gases that blanket the Earth and trap the sun's heat. Globally, a bit more than a quarter of electricity comes from wind, solar and other renewable sources which, as opposed to fossil fuels, emit little to no greenhouse gases or pollutants into the air.

2) Manufacturing goods

Manufacturing and industry produce emissions, mostly from burning fossil fuels to produce energy for making things like cement, iron, steel, electronics, plastics, clothes, and other goods. Mining and other industrial processes also release gases, as does the construction industry. Machines used in the manufacturing process often run on coal, oil, or gas; and some materials, like plastics, are made from chemicals sourced from fossil fuels. The manufacturing industry is one of the largest contributors to greenhouse gas emissions worldwide.

3) Cutting down forests

Cutting down forests to create farms or pastures, or for other reasons, causes emissions, since trees, when they are cut, release the carbon they have been storing. Each year approximately 12 million hectares of forest are destroyed. Since forests absorb carbon dioxide, destroying them also limits nature's ability to keep emissions out of the atmosphere. Deforestation, together with agriculture and other land use changes, is responsible for roughly a quarter of global greenhouse gas emissions.

4) Using transportation

Energy most cars, trucks, ships, and planes run on fossil fuels. That makes transportation a major contributor of greenhouse gases, especially carbon-dioxide emissions. Road vehicles account for the largest part, due to the combustion of petroleum-based products, like gasoline, in internal combustion engines. But emissions from ships and planes continue to grow. Transport accounts for nearly one quarter of global energy-related carbon-dioxide emissions.

5) Producing food

Producing food causes emissions of carbon dioxide, methane, and other greenhouse gases in various ways, including through deforestation and clearing of land for agriculture and grazing, digestion by cows and sheep, the production and use of fertilizers and manure for growing crops, and the use of energy to run farm equipment or fishing boats, usually with fossil fuels. All this makes food production a major contributor to climate change. And greenhouse gas emissions also come from packaging and distributing food.

6) Powering buildings

Globally, residential and commercial buildings consume a greater percentage of electricity. As they continue to draw on coal, oil, and natural gas for heating and cooling, they emit significant quantities of greenhouse gas emissions. Growing energy demand for heating and cooling, with rising air-conditioner ownership, as well as increased electricity consumption for lighting, appliances, and connected devices, has contributed to a rise in energy-related carbon-dioxide emissions from buildings in recent years.

7) Overconsumption

Our home and use of power, the food we eat and how much we throw away all contribute to greenhouse gas emissions. So does the consumption of goods such as clothing, electronics, and plastics. A large chunk of global greenhouse gas emissions are linked to private households. Our lifestyles have a profound impact on our planet.

Effects of climate change

1) Hotter temperatures

As greenhouse gas concentrations rise, so does the global surface temperature. The last decade, 2011-2020, is the warmest on record. Since the 1980s, each decade has been warmer than the previous one. Nearly all land areas are seeing more hot days and heat waves. Higher temperatures increase heat-related illnesses and make working outdoors more difficult. Wildfires start more easily and spread more rapidly when conditions are hotter. Temperatures in the Arctic have warmed at least twice as fast as the global average.

2) More severe storms

Destructive storms have become more intense and more frequent in many regions. As temperatures rise, more moisture evaporates, which exacerbates extreme rainfall and flooding, causing more destructive storms. The frequency and extent of tropical storms is also affected by the warming ocean. Cyclones, hurricanes, and typhoons feed on warm waters at the ocean surface. Such storms often destroy houses and communities, causing deaths and huge economic losses.

3) Increased drought

Climate change is changing water availability, making it scarcer in more regions. Global warming exacerbates water shortages in already water-stressed regions and is leading to an increased risk of agricultural droughts affecting crops, and ecological droughts increasing the vulnerability of ecosystems. Droughts can also stir destructive sand and dust storms that can move billions of tons of sand across continents. Deserts are expanding, reducing land for growing food. Many people now face the threat of not having enough water on a regular basis.

4) Global Warming

The ocean soaks up most of the heat from global warming. The rate at which the ocean is warming strongly increased over the past two decades, across all depths of the ocean. As the ocean warms, its volume increases since water expands as it gets warmer. Melting ice sheets also cause sea levels to rise, threatening coastal and island communities to evade away. In addition, the ocean absorbs carbon dioxide, keeping it away from the atmosphere. But more carbon dioxide makes the ocean more acidic which endangers marine life and coral reefs.

5) Loss of species

Climate change poses risks to the survival of species on land and in the ocean. These risks increase as temperatures increases. Exacerbated by climate change, the world is losing species at a rate 1,000 times greater than at any other time in recorded human history. One million species are at risk of becoming extinct within the next few decades. Forest fires, extreme weather, and invasive pests and diseases are among many threats related to climate change. Some species will be able to relocate and survive, but others will not.

6) Not enough food

Changes in the climate and increases in extreme weather events are among the reasons behind a global rise in hunger and poor nutrition. Fisheries, crops, and livestock may be destroyed or become less productive. With the ocean becoming more acidic, marine resources that feed billions of people are at risk. Changes in snow and ice cover in many Arctic regions have disrupted food supplies from herding, hunting, and fishing. Heat stress can diminish water and grasslands for grazing, causing declining crop yields and affecting livestock.

7) More health risks

Climate change is the single biggest health threat facing humanity. Climate impacts are already harming health, through air pollution, disease, extreme weather events, and forced displacement, pressures on mental health, and increased hunger and poor nutrition in places where people cannot grow or find sufficient food. Every year, environmental factors take the lives of around 13 million people. Changing weather patterns are leading to expanding diseases, increasing the deathrate and making it difficult for health care systems to keep up.

Prevention from climatic change

1. **Renewable energies:** Changing our main energy sources to clean and renewable energy. Solar, Wind, Geothermal and biomass could be the solution.
2. **Sustainable transportation:** Our transport methods must be aligned with environmental requirements and reduce their carbon footprint. It is essential to rethink our transport methods from the design stage towards eco-friendly transportation
3. **Air pollution prevention:** Many methods exist to prevent, control and reduce air pollution, in particular by reducing the consumption of fossil fuels, and limiting industry emissions and waste.
4. **Waste Management & recycling:** The simplest solution to reduce waste is to adapt our production methods to our consumption patterns. The recycling process must also be taken into account in our consumption habits.
5. **Sea and Ocean preservation:** Oceans and seas are the largest storage of greenhouse gases and are an exceptional support system for life on this planet. Limiting overfishing, unsustainable development

activities in coastal areas and the consumption of environmentally friendly products is now essential.

6. **Circular economy:** Adoption of 3 r's of circular economy (Reduce, Reuse and Recycle) to significantly reduce our waste and avoid unnecessary production of new items.

GLOBAL WARMING:

Global warming is the phenomenon of a gradual increase in the temperature near the earth's surface. This phenomenon has been observed over the past one or two centuries. This change has disturbed the climatic pattern of the earth. However, the concept of global warming is quite controversial, but the scientists have provided relevant data in support of the fact that the temperature of the earth is rising constantly.

There are several causes of global warming, which have a negative effect on humans, plants and animals. These causes may be natural or might be the outcome of human activities.

CAUSES FOR GLOBAL WARMING:

1) Natural causes of global warming:

- **Volcanoes:** Volcanoes are one of the largest natural contributors to global warming. The ash and smoke emitted during volcanic eruptions vanishes into the atmosphere and affects the climate.
- **Water Vapour:** Water vapour is a kind of greenhouse gas. Due to the increase in the earth's temperature, more water gets evaporated from the water bodies and stays in the atmosphere adding to global warming.
- **Melting Permafrost:** Permafrost is frozen soil that has environmental gases trapped in it for several years

and is present below Earth's surface. It is present in glaciers. As the permafrost melts, it releases the gases back into the atmosphere, increasing Earth's temperature.

- **Forest Blazes:** Forest blazes or forest fires emit a large amount of carbon-containing smoke. These gases are released into the atmosphere and increase the earth's temperature resulting in global warming.

2) Manmade causes of global warming

- **Deforestation:** Plants are the main source of oxygen. They take in carbon dioxide and release oxygen thereby maintaining environmental balance. Forests are being depleted for many domestic and commercial purposes. This has led to an environmental imbalance, thereby giving rise to global warming.
- **Use of Vehicles:** The use of vehicles, even for a very short distance results in various gaseous emissions. Vehicles burn fossil fuels which emit a large amount of carbon dioxide and other toxins into the atmosphere resulting in a temperature increase.
- **Chlorofluorocarbon:** With the excess use of air conditioners and refrigerators, humans have been adding CFCs into the environment which affects the atmospheric ozone layer. The ozone layer protects the earth surface from the harmful ultraviolet rays emitted by the sun. The CFCs have led to ozone layer depletion making way for the ultraviolet rays, thereby increasing the temperature of the earth.
- **Industrial Development:** With the advent of industrialization, the temperature of the earth has been increasing rapidly. The harmful emissions from the factories add to the increasing temperature of the earth. In

2013, the Intergovernmental Panel for Climate Change reported that the increase in the global temperature between 1880 and 2012 has been 0.9 degrees Celsius. The increase is 1.1 degrees Celsius when compared to the pre-industrial mean temperature.

- **Agriculture:** Various farming activities produce carbon dioxide and methane gas. These add to the greenhouse gases in the atmosphere and increase the temperature of the earth.
- **Overpopulation:** An increase in population means more people breathing. This leads to an increase in the level of carbon dioxide, the primary gas causing global warming, in the atmosphere.

EFFECTS OF GLOBAL WARMING:

Rise in Temperature: Global warming has led to an incredible increase in earth's temperature. Since 1880, the earth's temperature has increased by 1 degree. This has resulted in an increase in the melting of glaciers, which have led to an increase in the sea level. This could have a devastating effect on coastal regions.

Threats to the Ecosystem: Global warming has affected the coral reefs that can lead to the loss of plant and animal lives. Increase in global temperatures has made the fragility of coral reefs even worse.

Climate Change: Global warming has led to a change in climatic conditions. There are droughts at some places and floods at some. This climatic imbalance is the result of global warming.

Spread of Diseases: Global warming leads to a change in the patterns of heat and humidity. This has led to the movement of mosquitoes that carry and spread diseases.

- **High Mortality Rates:** Due to an increase in floods, tsunamis and other natural calamities, the average death toll usually increases. Also, such events can bring about the spread of diseases that can hamper human life.
- **Loss of Natural Habitat:** A global shift in the climate leads to the loss of habitats of several plants and animals. In this case, the animals need to migrate from their natural habitat and many of them even become extinct. This is yet another major impact of global warming on biodiversity.

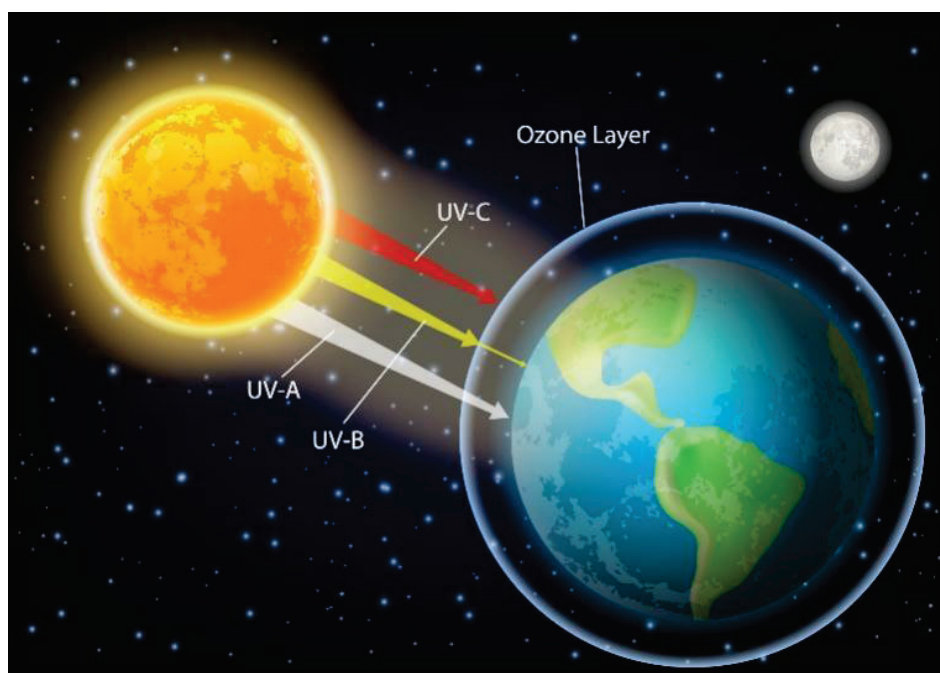
SOLUTIONS TO SOLVE GLOBAL WARMING

- **Change a light:** Replacing one regular light bulb with a compact fluorescent light bulb will save 150 pounds of carbon dioxide a year.
- **Drive less :** Walking, bike, carpool or taking mass transit more often can save one pound of carbon dioxide for every mile you don't drive!
- **Recycle more:** We can save 2,400 pounds of carbon dioxide per year by recycling just half of our household waste.
- **Check your tires:** Keeping tires inflated properly can improve gas mileage by more than 3 percent. Every gallon of gasoline saved keeps 20 pounds of carbon dioxide out of the atmosphere.
- **Use less hot water:** It takes a lot of energy to heat water. Use less hot water by taking shorter and cooler showers and washing clothes in cold or warm instead of hot water (more than 500 pounds of carbon dioxide saved per year).
- **Avoid products with a lot of packaging:** Saved 1,200 pounds of carbon dioxide can reduce garbage to 10 percent.

- **Adjust your thermostat:** Moving your thermostat down just 2 degrees in winter and up 2 degrees in summer could save about 2,000 pounds of carbon dioxide a year.
- **Plant a tree:** A single tree will absorb one ton of carbon dioxide over its lifetime.
- **Turn off electronic devices:** Simply turning off your television, DVD player, stereo, and computer, when not using them, will save us thousands of pounds of carbon dioxide a year.

OZONE LAYER DEPLETION:

Ozone layer depletion is the thinning of the ozone layer present in the upper atmosphere. This happens when the chlorine and bromine atoms in the atmosphere come in contact with ozone and destroy the ozone molecules. One chlorine can destroy 100,000 molecules of ozone. It is destroyed more quickly than it is created. Some compounds release chlorine and bromine on exposure to high ultraviolet light, which then contributes to ozone layer depletion. Such compounds are known as Ozone Depleting Substances (ODS).



The ozone-depleting substances that contain chlorine include chlorofluorocarbon, carbon tetrachloride, hydro chlorofluorocarbons, and methyl chloroform. Whereas the ozone-depleting substances that contain bromine are halons, methyl bromide, and hydro Bromo fluorocarbons.

Chlorofluorocarbons are the most abundant ozone-depleting substance. It is only when the chlorine atom reacts with some other molecule, it does not react with ozone. Montreal Protocol was proposed in 1987 to stop the use, production and import of ozone-depleting substances and minimise their concentration in the atmosphere to protect the ozone layer of the earth.

Causes for ozone depletion:

Ozone layer depletion is a major concern and is associated with a number of factors.

1. **Chlorofluorocarbons** :Chlorofluorocarbons or CFCs are the main cause of ozone layer depletion. These are released by solvents, spray aerosols, refrigerators, air-conditioners, etc. The molecules of chlorofluorocarbons in the stratosphere are broken down by ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.
2. **Unregulated Rocket Launches:** Researchers say that the unregulated launching of rockets results in much more depletion of the ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.
3. **Nitrogenous Compounds:** The nitrogenous compounds such as NO_2 , NO , N_2O are highly responsible for the depletion of the ozone layer.
4. **Natural Causes:** The ozone layer has been found to be depleted by certain natural processes such as Sunspots

and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion. The volcanic eruptions are also responsible for the depletion of the ozone layer.

Effects of ozone depletion

- **Effects on Human Health:**It results in serious health issues among humans such as skin diseases, cancer, sunburns, cataract, quick ageing and weak immune system.
- **Effects on Animals:**Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.
- **Effects on the Environment:** Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.
- **Effects on Marine Life:** Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed, the organisms present in the food chain are also affected.

Measures to curb ozone depletion

- ***Avoid Using ODS:***Reduce the use of ozone depleting substances. E.g., avoid the use of CFCs in refrigerators and air conditioners, replacing the halon-based fire extinguishers, etc.
- ***Minimise the Use of Vehicles:***The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimised as much as possible.
- ***Use Eco-friendly Cleaning Products:***Most of the cleaning products have chlorine and bromine releasing

chemicals that find a way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.

- **Use of Nitrous Oxide should be minimized:** People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimised at the individual level as well.

ACID RAIN

Acid rain is a form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions (low pH). Most water, including drinking water, has a neutral pH that exists between 6.5 and 8.5, but acid rain has a pH level lower than this and ranges from 4–5 on average. The more acidic the acid rain is, the lower its pH is.

Causes of acid rain

Acid rain results when sulphur dioxide (SO_2) and nitrogen oxides (NO_x) are emitted into the atmosphere and transported by wind and air currents. The SO_2 and NO_x react with water, oxygen and other chemicals to form sulphuric and nitric acids. These then mix with water and other materials before falling to the ground. While a small portion of the SO_2 and NO_x that cause acid rain is from natural sources such as volcanoes, most of it comes from the burning of fossil fuels. The major sources of SO_2 and NO_x in the atmosphere are:

- Burning of fossil fuels to generate electricity. Two thirds of SO_2 and one fourth of NO_x in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.
- Manufacturing, oil refineries and other industries.

Winds can blow SO₂ and NO_x over long distances and across borders making acid rain a problem for everyone and not just those who live close to these sources.

Effects of acid rain

1. Effects on Aquatic Life

The adverse effects are seen mostly in aquatic life forms and water bodies. Water flows through the soil, acidic rainwater leach, aluminium from the soil and further flows into streams and lakes. Some aquatic animals can tolerate acidic water but there are many animals which are acid-sensitive and are not able to tolerate acidic water. As a result, they die due to a decline in the pH level. Generally, the young ones in the aquatic ecosystem are adversely affected as they are acid sensitive. At pH 5, eggs of fish cannot hatch and at a lower pH level than this, some adult fishes also lose their life.

2. Effect on Forests

It makes trees vulnerable to disease, extreme weather, and insects by destroying their leaves, damaging the bark and arresting their growth. Forest damage due to acid rain is most evident in Eastern Europe – especially Germany, Poland and Switzerland.

3. Effect on Soil

Acid rain highly impacts on soil chemistry and biology. It means soil microbes and biological activity as well as soil chemical compositions such as soil pH are damaged or reversed due to the effects of acid rain.

The soil needs to maintain an optimum pH level for the continuity of biological activity. When acid rains seep into the soil, it means higher soil pH, damages or reverses soil biological and chemical activities. Hence, sensitive soil microorganisms that cannot adapt to changes in pH are killed.

High soil acidity also denatures enzymes for the soil microbes. On the same breadth, hydrogen ions of acid rain leach away vital minerals and nutrients such as calcium and magnesium.

4. Vegetation Cover and Plantations

The damaging effects of acid rain on soil and high levels of dry depositions have endlessly damaged high-altitude forests and vegetation cover since they are mostly encircled by acidic fogs and clouds. Besides, the widespread effects of acid rain on ecological harmony have led to stunted growth and even death of some forests and vegetation cover.

5. Effect on Architecture and Buildings

Acid rain on buildings, especially those constructed with limestone, reacts with the minerals and corrode them away. This leaves the building weak and susceptible to decay. Modern buildings, cars, airplanes, steel bridges and pipes are all affected by acid rain. Irreplaceable damage can be caused to the old heritage buildings.

6. Effect on Public Health

When in the atmosphere, sulphur dioxide and nitrogen oxide gases and their particulate matter derivatives like sulphates and nitrates, degrades visibility and can cause accidents, leading to injuries and deaths. Human health is not directly affected by acid rain because acid rainwater is too dilute to cause serious health problems.

However, the dry depositions also known as gaseous particulates in the air which in this case are nitrogen oxides and sulphur dioxide can cause serious health problems when inhaled. Intensified levels of acid depositions in dry form in the air can cause lung and heart problems such as bronchitis and asthma.

7. Other Effects

Acid rain leads to weathering of buildings, corrosion of metals, and peeling of paints on surfaces. Buildings and structures made of marble and limestone are the ones especially damaged by acid rain due to the reactivity of the acids in the rain and the calcium compounds in the structures. The effects are commonly seen on statues, old gravestones, historic monuments, and damaged buildings. Acid rain also corrodes metals like steel, bronze, copper, and iron.

ENVIRONMENTAL LAWS

Environmental law is the collection of laws, regulations, agreements and common law that governs how humans interact with their environment. The purpose of environmental law is to protect the environment and create rules for how people can use natural resources. Environmental laws not only aim to protect the environment from harm, but they also determine who can use natural resources and on what terms. Laws may regulate pollution, the use of natural resources, forest protection, mineral harvesting and animal and fish populations. As environmental laws progressed, lawmakers addressed the issue of standing. Individuals no longer need to be personally aggrieved in order to bring a claim to stop environmental contamination.

ENVIRONMENTAL PROTECTION ACT

India's original Constitution did not contain any provision for the protection of the natural environment. However, the Fundamental Duties, which were added by the 42nd Amendment to the Constitution, prescribed the protection of the environment including forests, lakes, rivers and wildlife as a duty of the citizens of the country.

Aims and Objectives of the EPA: The chief aims and objectives of the Environment Protection Act, 1986 are listed below.

1. Implementing the decisions made at the United Nations Conference on Human Environment held in Stockholm.
2. Creation of a government authority to regulate industry that can issue direct orders including closure orders.
3. Coordinating activities of different agencies that are operating under the existing laws.

4. Enacting regular laws for the protection of the environment.
5. Imposing punishments and penalties on those who endanger the environment, safety and health. For each failure or contravention, the punishment includes a prison term of up to five years or a fine of up to Rs. 1 lakh, or both. This can also be extended for up to seven years in cases.
6. Engaging in the sustainable development of the environment.
7. Attaining protection of the right to life under Article 21 of the Constitution.

Main Provisions of Environment Protection Act

The EPA empowers the Centre to “take all such measures as it deems necessary” in the domain of environmental protection.

- Under the law, it can coordinate and execute nationwide programmes and plans to further environmental protection.
- It can mandate environmental quality standards, particularly those concerning the emission or discharge of environmental pollutants.
- This law can impose restrictions on the location of industries.
- The law gives the government the power of entry for examination, testing of equipment and other purposes and power to analyse the sample of air, water, soil or any other substance from any place.
- The EPA explicitly bars the discharge of environmental pollutants in excess of prescribed regulatory standards.

- There is also in place a specific provision for handling hazardous substances, which is prohibited unless in compliance with regulatory requirements.
- The Act empowers any person, apart from authorised government officers, to file a complaint in a court regarding any contravention of the provisions of the Act.

The Air (Prevention and Control of Pollution)

Act was enacted in 1981 to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carry out the aforesaid purposes of Boards, for conferring on and assigning to such Boards powers and functions relating and for matters connected therewith. Whereas decisions were taken at the United Nations Conference on the Human Environment held in Stockholm in June, 1972, in which India participated, to take appropriate steps for the preservation of the natural resources of the earth which, among other things, include the preservation of the quality of air and control of air pollution;

The Water (Prevention and Control of Pollution)

The Water (Prevention and Control of Pollution) Act, 1974 the first of a series of legislation passed by the Government of India pertaining to regulation of environmental aspects in the country. Rising water pollution due to industrial and domestic activities became a cause of concern, leading to the enactment of this legislation. This Act was followed by the Air (Prevention and Control of Pollution) Act, 1981, Environment Protection Act, 1986, Noise Pollution (Regulation and Control) Rules, 2000, and Municipal Solid Wastes (Management and Handling) Rules, 2000 (the last one was recently replaced by Solid Waste Management Rules (SWM), 2016). This post is a summary of the Water (Prevention and Control of Pollution) Act, 1974.

The main feature of the Water Act is the control of pollution through a permit or “consent administration” procedure. Discharge of effluents into water bodies was only allowed by obtaining the consent of the State Board, within restrictions it poses.

The Wild Life (Protection) Act

Act of the Parliament of India enacted for protection of plants and animal species. Before 1972, India had only five designated national parks. Among other reforms, the Act established schedules of protected plant and animal species; hunting or harvesting these species was largely outlawed. The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. It extends to the whole of India.

It has six schedules which give varying degrees of protection. Schedule I and part II of Schedule II provide absolute protection - offences under these are prescribed as the highest penalties. Species listed in Schedule III and Schedule IV are also protected, but the penalties are much lower. Animals under Schedule V, e.g. common crows, fruit bats, rats and mice, are legally considered as vermin and may be hunted freely.^[2] The specified endemic plants in Schedule VI are prohibited from cultivation and planting. The hunting to the Enforcement authorities have the power to compound offences under this Schedule (i.e. they impose fines on the offenders). Up to April 2010 there have been 16 convictions under this act relating to the death of tigers.

FOREST CONSERVATION ACT

The Forest (Conservation) Act of 1980 (FCA, 1980) is an act by the Parliament of India which ensures conservation of forest and its resources.

It was enacted by the Parliament of India in order to control the ongoing deforestation of the forests of India. It came into force on October 25, 1980 containing five sections.

Amid news reports mentioning future amendments to the FCA 1980 by the Environment Ministry, the act and its provisions is important from the current affairs perspective.

This article will further give details about the Forest Conservation Act, 1980.

INTERNATIONAL AGREEMENTS: MONTREAL AND KYOTO PROTOCOLS

MONTREAL PROTOCOL:



The Montreal Protocol enforced in 1987 initiated a global strategy for the protection of the ozone layer by forbidding the industrialised countries and from 2004 the developing countries as well to produce and consume those substances that are assumed to be responsible for the destruction of stratospheric ozone.

KYOTO PROTOCOL:

The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol.

In short, the Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically.

The Kyoto Protocol is based on the principles and provisions of the Convention and follows its annex-based structure. It only binds developed countries, and places a heavier burden on them under the principle of “common but differentiated responsibility and respective capabilities”, because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere

CONVENTION OF BIOLOGICAL DIVERSITY:

The Convention on Biological Diversity (CBD) is the international legal instrument for "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources" that has been ratified by 196 nations.

Its overall objective is to encourage actions, which will lead to a sustainable future.

The conservation of biodiversity is a common concern of humankind. The Convention on Biological Diversity covers biodiversity at all levels: ecosystems, species and genetic resources. It also covers biotechnology, including through the Cartagena Protocol on Biosafety. In fact, it covers all possible domains that are directly or indirectly related to biodiversity and its role in development, ranging from science, politics and education to agriculture, business, culture and much more.

NATURAL RESERVES

A nature reserve (also known as a wildlife refuge, wildlife sanctuary, biosphere reserve or bioreserve, natural or nature preserve, or nature conservation area) is a protected area of importance for flora, fauna, or features of geological or other special interest, which is reserved and managed for purposes of conservation and to provide special opportunities for study or research. They may be designated by government institutions in some countries, or by private landowners, such as charities and research institutions. Nature reserves fall into different IUCN categories depending on the level of protection afforded by local laws. Normally it is more strictly protected than a nature park. Various jurisdictions may use other terminology, such as ecological protection area or private protected area in legislation and in official titles of the reserves. There are several national and international organizations that oversee the numerous non-profit animal sanctuaries and refuges in order to provide a general system for sanctuaries to follow. Among them, the American Sanctuary Association monitors and aids in various facilities to care for exotic wildlife. The number of sanctuaries has substantially increased over the past few years.

Benefits of natural reserves

- **Protects Animals and Plants:** Guarded areas directly deliver the primary driver of extermination, environmental loss, which endangers over 80% of different animals and plants globally.
- **Provides Knowledge and Value:** Reserves give opportunities to connect with nature and carry out different activities such as hunting, fishing, and gathering by providing the locals and tourists with a way to experience nature from a distance through a game drive.

Most natural reserves have a management system which sets and collects park fees from visitors. Through this, they can learn about different species and habitats and understand their value.

- **Safe Habitat for Plants and Animals :**With the effects of global warming becoming a reality, nature reserves serve as a habitat for different species of animals, birds, and plants. Nature reserves also help protect endangered species from poachers and other predators.
- **Economy Benefits:** Nature reserves are beneficial to the economy as they help increase revenue because locals and tourists want to visit the area and to do so, have to pay visiting fees. It creates an opportunity for employment because it's essential to professionally manage the reserves. Some employment opportunities include tour guides, researchers, marketers, and animal and plant specialists.
- **Protects Indigenous People's Land Rights:** In some countries, natural reserves are set up to protect indigenous people's land rights, especially in Africa and the Far East. In this case, the land is owned by all community members, hence helping protect their culture and beliefs. This acts as a tourist destination where the community raises money for community projects through park fees.

TRIBAL POPULATION

Tribal peoples are peoples who are “not indigenous to the region [they inhabit], but they share similar characteristics with indigenous peoples, such as having social, cultural and economic traditions different from other sections of the national community, identifying themselves with their

ancestral territories, and regulating themselves, at least partially, by their own norms, customs, and traditions”

RIGHTS

1. Right to hold and live in the forest land under the individual or common occupation for habitation or for self-cultivation for livelihood by a member or members of a forest dwelling Scheduled Tribe or other traditional forest dwellers.
2. Community rights such as *nester*, by whatever name called, including those used in erstwhile Princely states, Zamindari or such intermediary regimes.
3. The right of ownership, access to collect, use, and dispose of minor forest produce (includes all non-timber forest produce of plant origin) which has been traditionally collected within or outside village boundaries.
4. Other community rights of uses of entitlements such as fish and other products of water bodies, grazing (both settled or transhumant) and traditional seasonal resource access of nomadic or pastoralist communities.
5. Rights including community tenures of habitat and habitation for primitive tribal groups and pre-agriculture communities.
6. Rights in or over disputed lands under any nomenclature in any State where claims are disputed.
7. Rights for conversion of Pattas or leases or grants issued by any local council or any State Govt. on forest lands to titles.
8. Rights of settlement and conversion of all forest villages, old habitation, unsurvey villages and other villages in

forest, whether recorded, notified or not into revenue villages.

9. Right to protect, regenerate or conserve or manage any community forest resource which they have been traditionally protecting and conserving for sustainable use.
10. Rights which are recognised under any State law or laws of any Autonomous Dist. Council or Autonomous Regional Council or which are accepted as rights of tribal under any traditional or customary law of the concerned tribes of any State;
11. Right of access to biodiversity and community right to intellectual property and traditional knowledge related to biodiversity and cultural diversity.

HUMAN WILDLIFE CONFLICTS IN INDIA:

Biodiversity is fundamental to sustain ecosystem processes, functions and the continued delivery of ecosystem services, which are the foundation of livelihood security, health and overall well-being of human societies. Conservation of biodiversity and wildlife preserves cultural heritage and natural ways of living. It is essential for India, because the consequences of biodiversity loss and the resulting loss of ecosystem services have a far-reaching impact on the overall wellbeing of the population.

The situation in India is, however, changing. Human population increase and its consequent demand for natural resources has led to degradation and fragmentation of natural habitats. As a result, humans and wildlife compete for the same diminishing resources. This shift from co-existence to conflict has the potential to undermine existing and future conservation

efforts, and also hinder the achievement of the Sustainable Development Goals (SDGs) and the Aichi Biodiversity Targets.

Human-wildlife conflict can have a negative impact, especially on rural Indian communities, so far causing economic losses amounting to millions of rupees. Intensive crop damage and the increasing frequency of animal attacks on both humans and their cattle have made communities less tolerant towards wildlife, mainly due to the emotional stigma attached. Mitigation of human-wildlife conflict is thus becoming one of the key issues of concern for both wildlife managers and the scientific community. There is a need to create an enabling environment for them to address the situation, and to strengthen their capacities in the most efficient and effective manner.

Management of Human wildlife conflict in India is an urgent and important issue. It is necessary to address the issue in a holistic manner, and co-create the mitigation solutions, with full engagement of all the relevant stakeholders. There is a need for

- Development of a strategy and action plan to reduce human-wildlife conflict at a national level and in selected states
- Pilot application of a holistic approach and instruments to mitigate human-wildlife conflicts at pilot sites in three project partner states
- Facilitation of capacity development for key stakeholders to mitigate human-wildlife conflict in India

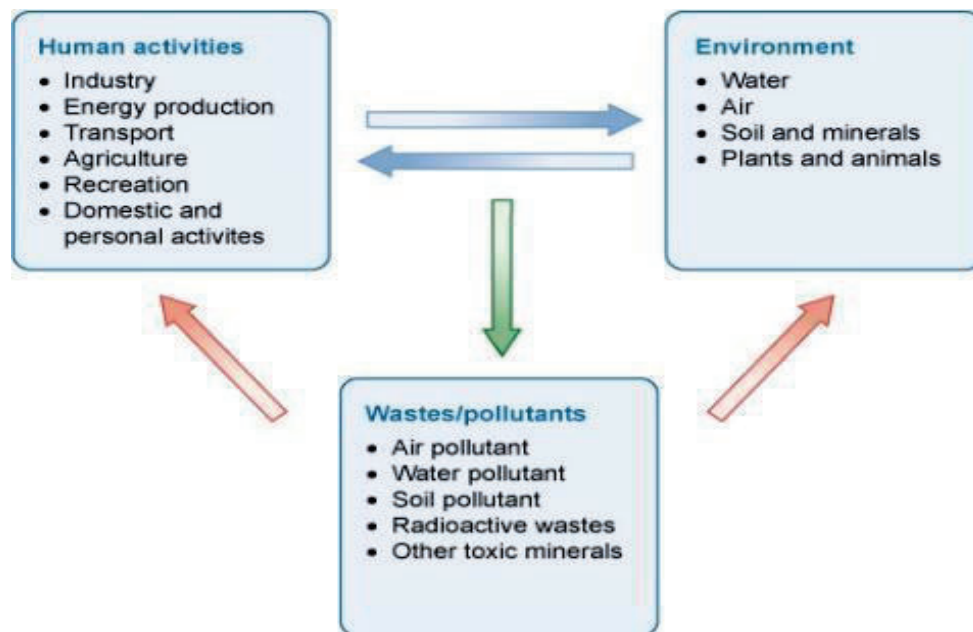
REVIEW QUESTIONS:

1. What is climate change?
2. What is global warming?
3. What are the reasons for ozone layer depletion?
4. Discuss briefly about acid rain and its impact.
5. What is environmental law?
6. Explain air (prevention and control of pollution) act & water (prevention and control of pollution) act.
7. Explain forest conservation act and wildlife protection act.

UNIT -7

HUMAN COMMUNITIES AND THE ENVIRONMENT

Humans need to interact with the environment to obtain our food, water, fuel, medicines, building materials and many other things. Advances in science and technology have helped us to exploit the environment for our benefit, but we have also introduced pollution and caused environmental damage. It is the relationship of people with the natural and physical environment around them. Environment includes physical, biological, cultural, social, and economic factors of the area.

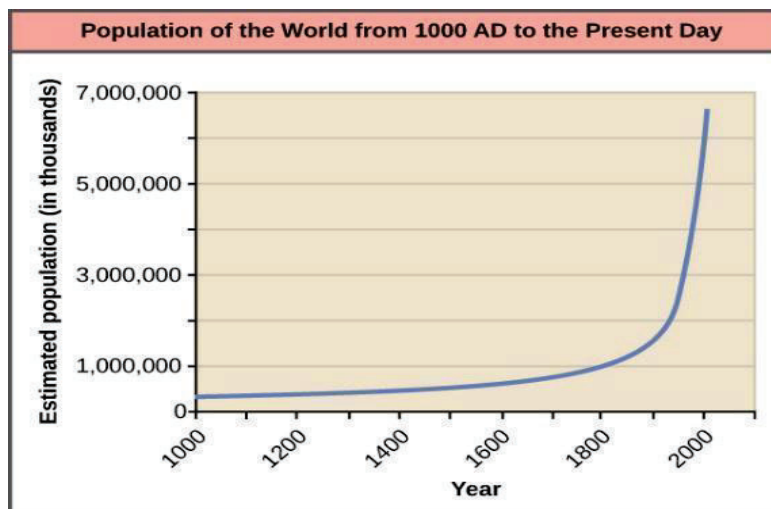


Humans impact the physical environment in many ways: overpopulation, pollution, burning fossil fuels, and deforestation. Changes like these have triggered climate change, soil erosion, poor air quality, and undrinkable water.

Human Population Growth



The population growth or population change refers to the change in number of individuals or inhabitants present in a territory during a specific period of time. This change may be positive as well as negative. It can be expressed either in terms of absolute numbers or percentage.



Population change in an area is an important indicator of economic development, social upliftment, historical and cultural background of the region in question. Population growth is considered to be one of the driving forces behind current environmental problems, because the growing

population demands more (non-renewable) resources for its own use. Population explosion refers to the sudden and rapid unprecedented growth in size of population, especially human population; mainly as a result of the following:

- Increased birth rate;
- Decreased infant mortality rate; and
- Improved life expectancy.

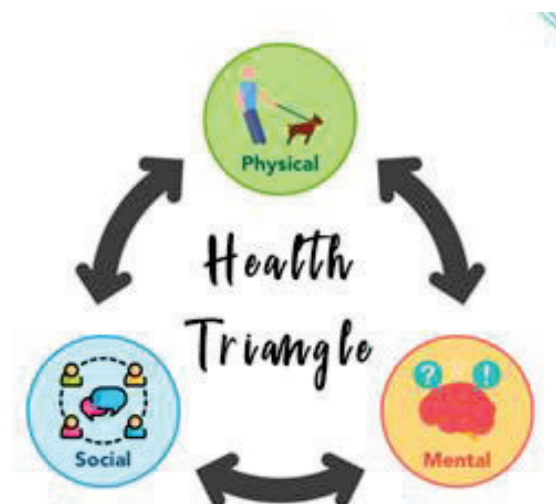
The genetic and archaeological records suggest that there was a dramatic collapse in the world human population around 70,000 years ago. Subsequently, numbers recovered coincident with the emergence of food production owing to the development of agriculture during past 10,000 years. However, despite localized population collapses brought about by famine, war, and disease, on a global scale the population continued to increase. It is estimated that it took a substantial amount of time (hundreds of years) for the world population to grow to one billion.

On the contrary, in just 200 years, the population grew sevenfold. In 2011, the global population touched the 7 billion mark, and as on today, it stands at about 7.6 billion. Some of the key reasons behind this dramatic increase in human population are highlighted below. Enormous changes in fertility rates and increased life expectancy of women, however, average total fertility for the world has declined to about two children per woman; Increase in average global lifespan, from 64.6 years in the early 1990s to 70.8 years today; Advances in modern medicines and improved healthcare facilities; Improvements in living standards and levels of personal hygiene. It is estimated that the world population will continue to grow for decades to come as a result of 'population momentum,' because of improved survival rates and past high fertility levels, there are more women of reproductive age

today. This will contribute to a relatively large number of births, even if those women have fewer children on average. These trends will have far reaching implications for generations to come. These would affect economic development, employment, income distribution, poverty, and social protections.

HUMAN HEALTH AND WELFARE:

A broad and widely used definition of health given by the World Health Organization (WHO) is that it is “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. One measure of health is the ability to function effectively within a given environment. Since the physical, biological and social environment keeps on changing throughout the life of an individual, good health involves a process of continuous adaptation to such changes.



Environmental health can be defined as “the aspect of public health that is concerned with all external conditions such as all forms of life, substances, forces, problems and challenges and any other condition in the surroundings of human being that may exert an influence on their health and well-being”. Disease, in this sense, represents a maladjustment of the human being to her environment. Although ancient civilizations were

aware of the effects of environment on health, the importance of clean environment in the modern times was realized in Europe only after the Industrial Revolution in 1842. It was known as “the great sanitary awakening”. As a consequence, the discipline of Public Health was established. It was defined as the science and art of preventing disease, prolonging life and promoting health and efficiency through organized community effort. The objectives of public health are given below.

Public Health

- The sanitation of environment
- The control of communicable disease
- Education in personal hygiene
- Organization of health services of early diagnosis and prevention of disease
- The development of social machinery to ensure everyone a standard of living for maintenance of health

So far, in the developing countries like ours, significant success has not been achieved for such desirable goals of public health. However, in developed countries, communicable diseases have been almost eradicated by improving sanitary conditions. So the emphasis in public health has moved to the preventive, therapeutic and rehabilitative aspects of chronic diseases and behavioral disorders, like smoking, drug abuse and alcoholism which are prevalent in these countries. Thus, today, public health gives emphasis on planning and evaluation of health activities, programs and systems. With such challenges, public health is now termed ‘Community Health’.

REVIEW QUESTIONS

1. Describe human population growth.
2. Explain human wealth and welfare

RESETTLEMENT AND REHABILITATION

Rehabilitation and Resettlement (R&R) benefits extended to Project Affected Persons (PAPs) R&R issues of the project affected persons are addressed by NTPC by formulating a comprehensive R&R Plan in consultation with stakeholders including PAPs and the respective district administration.



People are forced to move out of their land due to both natural and man-made disasters. Natural disasters like earthquakes, cyclones, tsunami etc. render thousands of people homeless and sometime even force them to move and resettle in other areas. Similarly, developmental projects like construction of roads, dams, canals and flyovers displace people from their home. You must all be aware of the recent nuclear leakage in Japan due to which millions of people were forced to leave the area for their safety. Thus, resettlement refer to the process of settling again in a new area. Rehabilitation means restoration to the former state.

Reasons for displacement of people

- Natural disasters like earthquake, cyclones, tsunamis, volcanic eruptions, prolonged droughts conditions, floods, hurricanes etc.
- Man-made disasters like industrial accidents (e.g. Bhopal gas tragedy), nuclear accidents (Current disaster in Japan), oil spills (Exxon Valdez oil spill), toxic contamination of sites etc.
- In search of better employment opportunities.
- Developmental projects like: construction of dams, irrigation canals, reservoirs etc.
- Infrastructural projects like flyovers, bridges, roads etc.
- Transportation activities like roads, highway, canal etc.
- Energy related project like power plants, oil exploration, mining activities, pipelines like HBJ pipeline etc.
- Agricultural projects
- Projects related with the conservation of wildlife like national parks, sanctuaries and biosphere reserves.

Resettlement issues :As per the World Bank estimates, nearly 10 lakh people are displaced worldwide for a variety of reasons. I have tried to mention a few of the sufferings that these people have to face but we are unable to feel for them:

Little or no support: Displacement mainly hits tribal and rural people who usually do not figure in the priority list of any political authorities or parties.

Meager compensation: The compensation for the land lost is often not paid, it is delayed or even if paid, is too small both

in monetary terms and social changes forced on them by these mega developmental projects.

Loss of livelihood: Displacement is not a simple incident in the lives of the displaced people. They have to leave their ancestral land and forests on which they depend for their livelihood. Many of them have no skills to take up another activity or pick up any other occupation. Usually, the new land that is offered to them is of poor quality and the refugees are unable to make a living.

Lack of facilities: When people are resettled in a new area, basic infrastructure and amenities are not provided in that area. Very often, temporary camps become permanent settlements. It is also a major problem of displacement or resettlement that people have to face.

Increase in stress: Resettlement disrupt the entire life of the people. They are unable to bear the shocks of emptiness and purposelessness created in their life. Payment of compensation to the head of the family often lead to bitter quarrels over sharing of compensation amount within the family, leading to stress and even withering of family life. Moreover, land ownership has a certain prestige attached to it which cannot be compensated for even after providing the new land.

Increase in health problems: Lack of nutrition due to the loss of agriculture and forest based livelihood, lead to the general decline in the health of the people. People are used to traditional home remedies. But the herbal remedies and plants gets submerged due to the developmental projects.

Objectives of rehabilitation

- Tribal people should be allowed to live along the lives of their own patterns and others should avoid imposing anything on them.

- They should be provided means to develop their own traditional art and culture in every way.
- Villagers should be given the option of shifting out with others to enable them to live a community-based life.
- Removal of poverty should be one of the objectives of rehabilitation.
- The displaced people should be given employment opportunities.
- Resettlement should be in the neighbourhood of their own environment.
- Villagers should be taken into confidence at every stage of implementation of the displacement and they should be educated, through public meetings, discussion about the legalities of the Land Acquisition act and other rehabilitation provisions.

REVIEW QUESTIONS

1. What are the Objectives of rehabilitation
2. Discuss about Resettlement issues

DISASTER MANAGEMENT

According to the World Health Organization, an environment disaster or calamity is an event that causes damage, economic disruption, loss of human life and deterioration in the health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area. Natural calamities adversely affect the lives of a large number of people, causing considerable damage to infrastructure and property. The ill effects are more pronounced in developing countries due to the lack of preparedness, lack of systems for sufficient warning, and lack of facilities for quick access to the site of calamity. At the global level, Asia is more prone to natural calamities. It is reported that for each major natural calamity in Europe and Australia, there are ten in Latin America and Africa and fifteen in Asia. According to the Centre for Renewable Energy Development (CRED) World Disaster Report (1998), the ratio of those killed to those affected depends on the type of calamity, degree of preparedness and the density of population.



EARTHQUAKES

An earthquake occurs due to vibrations(s) of the Earth produced by the release of energy. This energy radiates in all directions from its source (epicenter). Earthquakes can also

occur because of atomic (nuclear) explosions or by volcanic eruptions. Large reservoirs with their hydro-static pressure of water may also induce earthquake.



In order to understand the strength and severity of an earthquake, it is necessary to measure its intensity. There are several methods to measure the intensity of the effect an earthquake produces on life and property. The Richter scale describes the amplitude of the earthquake wave radiating out in all directions from the focus (epicenter) which is closely related to the amount of energy released. This is also a measure of ground motion as recorded on a seismograph.

FLOODS

Floods are the most common of all natural calamities. Floods regularly claim thousands of lives and adversely affect millions of human beings annually worldwide. Bangladesh and India together account for over two-third of global death count each year. More than the loss of life and damage to property, millions of people are displaced every year due to floods in the South Asian countries.



A flood is the discharge of water that exceeds the canal capacity of the river. Floods are caused by different factors that include:

- climate extremes – heavy and prolonged rainfall
- melting of snow and ice
- collapse of dams
- deforestation and land slides
- silting of river beds reducing the carrying capacity of rivers
- Lack of coordination between officials of adjoining countries or states facing similar problems.

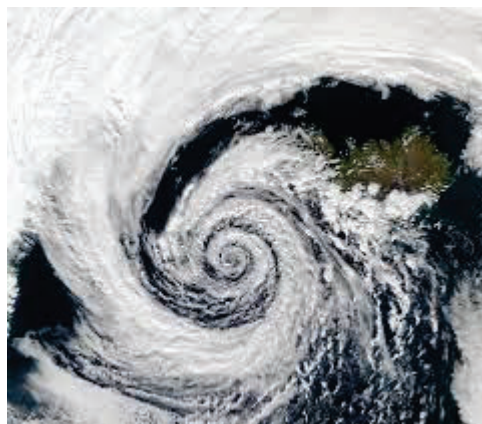


It is possible to reduce the adverse effects of floods by construction of dams and reservoirs at appropriate places, strengthening the embankments on rivers and canals, improving the carrying capacities of rivers, canals and reservoirs by periodical deepening and deepening operations. Weather

forecasting and flood plain management techniques can help in minimizing casualties and damage.

CYCLONE

A cyclone is a general term for a weather system in which the inward rotation of winds takes place around an area of low atmospheric pressure. One of the most common coastal calamities is the cyclone. Cyclones are caused in the tropical belt when sea water gets heated up to 27 degrees Celsius and more, so that low pressure areas develop above the water levels. The low-pressure areas remain the same for three to four days and draw energy from the sea surface. As the pressure in the Centre falls, the wind speed increases and cloud burst starts spiralling around the Centre causing squalls. As the pressure falls in the Centre, the winds in the surrounding areas rush inwards creating spirally moving storms. The cyclone then moves landward towards areas of lowest pressure. Strong winds and heavy rain destroy and annihilate weather comes in their way.



A tropical cyclone that struck northern Bay of Bengal in 1970 caused tidal waves of 6 meters height killing three hundred thousand people and destroying 65% of the total fishing capacity of the coastal region. Today, with the advancement in weather prediction techniques, remote sensing

satellites and cooperation between countries in sharing information on weather conditions, it is possible to predict the occurrence of a cyclone and monitor its movements to pinpoint the area where it is likely to hit the coast. In spite of this, the damage caused is very severe, the well-planned relief operations going haywire in the last minute.

LANDSLIDE

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. Landslides are caused by disturbances in the natural stability of a slope. They can accompany heavy rains or follow droughts, earthquakes, or volcanic eruptions. Mudslides develop when water rapidly accumulates in the ground and results in a surge of water-saturated rock, earth, and debris.



People affected by landslides can also have short- and long-term mental health effects due to loss of family, property, livestock or crops. Landslides can also greatly impact the health system and essential services, such as water, electricity or communication lines. A fall-type landslide results in the collection of rock or debris near the base of a slope. A good example of a fall landslide is the rock fall at Pennington Point.

REVIEW QUESTION

1. Briefly discuss about disaster management

ENVIRONMENTAL MOVEMENT

An environmental movement is a type of social movement that involves an array of individuals, groups and coalitions that perceive a common interest in environmental protection and act to bring about changes in environmental policies and practices.

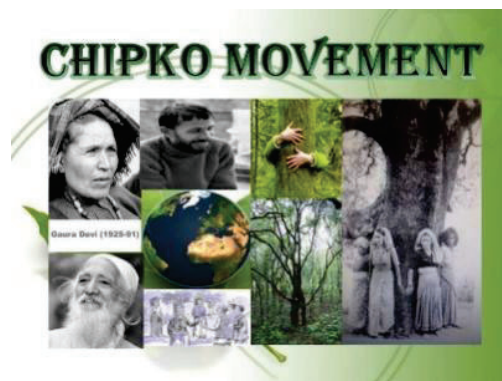
The environmental movement is an international movement, represented by a range of organizations, from enterprises to grassroots and varies from country to country. Due to its large membership, varying and strong beliefs, and occasionally speculative nature, the environmental movement is not always united in its goals. The movement also encompasses some other movements with a more specific focus, such as the climate movement. At its broadest, the movement includes private citizens, professionals, religious devotees, politicians, scientists, nonprofit organizations, and individual advocates.

The environmental movement has sought to protect the natural world through a number of initiatives, including reducing pollution, conserving natural resources, preventing endangered species from becoming extinct, and shielding natural areas from destruction or over development.

CHIPKO MOVEMENT

The word 'Chipko' in Hindi means 'to embrace' or 'to hug,' as villagers during the movement hugged the trees preventing their chopping. In local vernacular it is popularly known as Angwal. The movement is best known for its tactic of hugging trees to prevent them being cut down in order to prevent commercial timber harvesting. The Chipko movement is considered to be one of the environmental movements of grassroots origin in India. This movement focused world's

attention on the environmental problems of the Alaknanda catchment area in the northern Himalayan region.



Post Indo-Chinese border issues during 1960s; extensive networks of roads were built throughout the lower Himalayan region as a strategic move. This resulted in opening of the region's natural resources to entrepreneurs from various regions of India. During March 1973, confrontation occurred in Chamoli district of Uttar Pradesh (now under Uttarakhand state), where a group of women, led by Gaura Devi (an elderly woman) blocked an army of lumberjacks, against cutting of natural forests trees by private contractors hired by a sports good manufacturing company. Local residents hugged the earmarked trees when the trees were about to be axed. Later, the same tactic was used by the villagers in some other areas of the state to save trees.

The movement later became popular under the leadership of Chandi Prasad Bhatt, a Marxist and Sunderlal Bahuguna, a Gandhian. Later Chipcoactivists' undertook afforestation programmes in nearby villages with the help of some voluntary organizations. Chipko's appeal was uniquely wide-ranging. Thus the movement was co-opted, shaped, and popularized by groups as diverse as local and global journalists, environment activists, Gandhians, spiritual leaders, politicians, and feminists. The feminist movement popularized Chipko, pointing out that poor rural women walk long distances to

collect fuel and fodder, and thus were the frontline victims of forest destruction.

SILENT VALLEY

The densely forested valley in the Palghat district of north Kerala is known as the 'Silent Valley'. It has a triangular shape. On two sides are the Kozhikode and Palghat cities in Kerala and on the other side is located the Coimbatore city in neighboring Tamil Nadu. Silent valley is famous for many rare species of birds and animals. Birdlife International listed 16 bird species in Silent Valley as threatened or restricted. The mammals in the valley include Gaur, the largest of all wild cattle. There are at least 34 species of mammals at Silent Valley, including the threatened species of mammals. Over 128 species of butterflies and 400 species of moths live here. It is identified as a region with high biodiversity and an important Gene Pool resource for Recombinant DNA innovations by the Indian Council of Agricultural Research, ICAR (India).

Silent Valley Movement was a movement against the state to protect Silent valley, an evergreen tropical forest in the Palakkad district of Kerala, India. It was started in 1973 to save the Silent Valley Reserve Forest from being flooded by a hydroelectric project. In 1983, the Central Government instructed the State government to abandon the Project and on November 15, the Silent Valley forests were declared as a National Park..

BISHNOIS OF RAJASTHAN

Bishnoi Movement was started around 260 years back in the early part of the 18th century in Rajasthan by the Bishnoi

community. A large group of them from 84 villages led by a lady called Amrita Devi laid down their lives in an effort to protect the trees from being felled on the orders of the Maharaja (King) of Jodhpur. It is one of the first organized proponents of eco-conservation, wildlife protection, and green living.



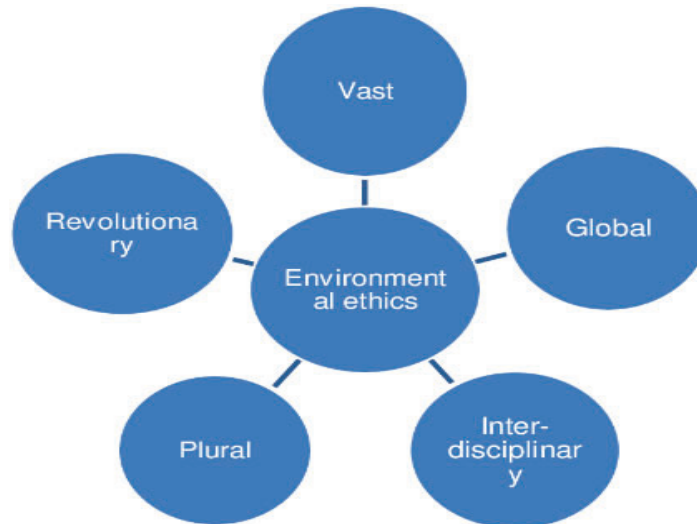
It is documented that in 1730 AD, 363 people including Amrita Devi, a Bishnoi woman leader, who steered this movement further, sacrificed their lives in an effort to prevent the felling of Khejri (*Prosopis cineraria*) trees, which in Rajasthan are treated with reverence. This movement was the first of its kind to have developed the strategy of hugging or embracing the trees for their protection spontaneously. The Bishnoi's embrace of trees can be found the precedence for the famous 'Chipko' movement (of 1973) in northern Himalayas of India, where again women hugged the trees to resist the depredations of loggers and contractors.

REVIEW QUESTION

1. What is environmental movement and its types?

ENVIRONMENTAL ETHICS

Environmental ethics is a branch of applied philosophy that studies the conceptual foundations of environmental values as well as more concrete issues surrounding societal attitudes, actions, and policies to protect and sustain biodiversity and ecological systems.



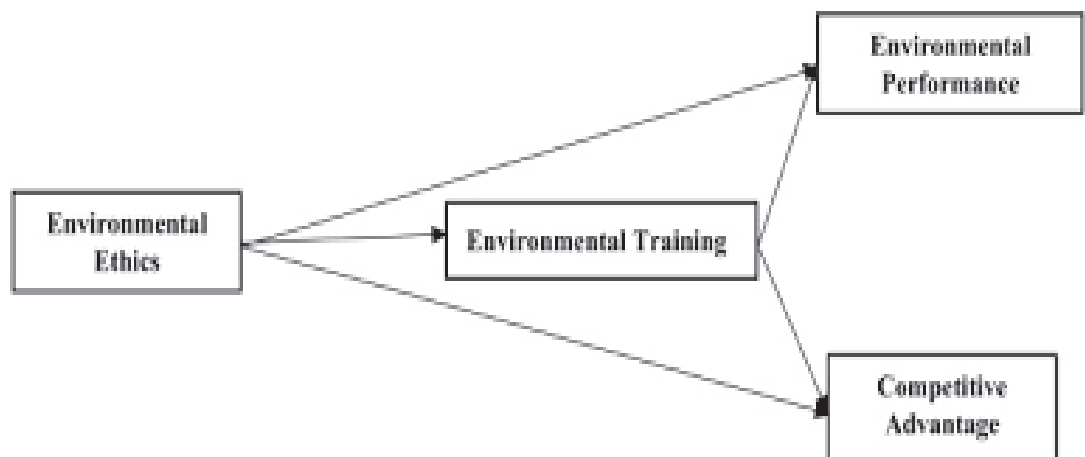
Environmental Ethics deal with issues related to the rights of individuals that are fundamental to life and well-being. These concern not only the needs of each person today, but also those who will come after us. It also deals with the rights of others living creatures that inhabit the Earth.

Nowadays, human acts lead to environmental pollution. The high demand of the earth resources is a factor that leads to that environmental pollution. Hence, we need those environmental ethics to keep the sustainability.

With environmental ethics, you can ensure that you are doing your part to keep the environment safe and protected. Every time that a tree is cut down to make a home or other resources are used, we are using natural resources that are becoming more and sparser to find.

Environmental ethics can be defined as the philosophic study that examines the ethical relationship of humans and the environment. The philosophy also explores the moral relationship humans have with Earth, animals, and plants. Ethics or moral philosophy is the branch of philosophy that involves systematizing, defending, and recommending concepts of right and wrong conduct.

Environmental ethics is the discipline in philosophy that studies the moral relationship of human beings to, and also the value and moral status of, the Environment and its human conduct. They are moral principles governing the human attitude towards the environment, and rules of conduct for environmental care and preservation. While the phrase ‘environmental ethics’ is sometimes used to refer simply to the Ethical (or unethical) character of people’s behavior where it affects the natural Environment, it is important that this phrase is also used not just of behavior but also of the normative principles applicable to it, and their critical study. This critical study Is itself widely known as environmental ethics.



ROLE OF INDIAN AND OTHER RELIGIONS AND CULTURE IN ENVIRONMENTAL ETHICS

Virtually all the countries of the world have rich traditions embedded in the ethics of protecting nature. Many ancient cultures tell us how communities lived in harmony with nature, with a tradition of reverence for the elements that constitute ecosystems, drawing their sustenance from natural resources and at the same time protecting the environment that sustains them. Modern man tends to look down upon indigenous people as primitive, backward and superstitious. They may be poor, illiterate, and disadvantaged in many other ways, but they have a tremendous understanding of ecosystems and the factors that sustain them. In the words of Sitakant Mahapatra (1992): "They still look upon life as a gift to be celebrated; and this ancient Earth as one to be praised, worshipped and also celebrated. They are the one to whom the earth is not something to be used, not a possession or an object for exploitation but a living entity, an object of reverence, and the relationship is one of sacred trust and loving intimacy. For, they believe as much in celebrating one's life in this world as in remembering, adoring and celebrating the world in one's life. The sacred soil of ancestors into which one is born is thus a part of one's fundamental psychic experience of life and is a part of its spiritual dimension. The earth, the land, the village enter into and are secure in racial memory and it is only an ethical imperative to worship the Earth goddess, the Mother Earth."

The worship of Mother Earth is a universal phenomenon in many indigenous cultures. There are innumerable examples of festivals, rituals, songs, and myths that celebrate the gifts of Mother Earth all over the world, revealing the intimate sense of togetherness and harmony that exists between man and nature in tribal societies. An American - Indian community, the Sioux Indians, refused to till the soil

because they did not want to wound the body of their mother, the Earth. Indigenous people in many countries attribute supernatural powers to plants, animals, rivers, oceans, mountains, the wind, sun and moon. Respect for nature is inherent in many religious faiths. Many Hindu gods and goddesses are shown to use animals as mounts. Sacred groves or sacred forests preserved with reverence have been part of Hindu and Buddhist culture. In Christianity as well as in Islam, conservation of the environment is based on the principle that nature and its components are created by God, and humans are entrusted with the responsibility of protecting it. Many religions and moral philosophies have professed the unity of all life on earth and the obligation of human beings to care for them.

Today, when people throughout the world are perturbed by the degradation of the environment and the disastrous consequences of this, traditional ethics of nature conservation could be looked upon as a source of inspiration and guidance for the future. Perhaps no other culture can provide such a profound variety of cultural practices and ecologically sound relationship with nature as the Indian. This chapter is an attempt to bring together some of the information available on this aspect of Indian culture from various sources.

THE INDIAN TRADITION

For the people of India, environmental conservation is not a new concept. Historically, the protection of nature and wildlife was an ardent article of faith, reflected in the daily lives of people, enshrined in myths, folklore, religion, arts, and culture. Some of the fundamental principles of ecology—the interrelationship and interdependence of all life—were conceptualized in the Indian ethos and reflected in the ancient scriptural text, the *Isopanishad*, over 2000 years ago. It says, 'This universe is the creation of the Supreme Power meant for

the benefit of all his creation. Each individual life-form must, therefore, learn to enjoy its benefits by forming a part of the system in close relation with other species.

The oldest visual image of the human fascination, love, and reverence for nature in India can be found in the 10,000-year-old cave paintings at Bhimbetka in Central India depicting birds, animals, and human beings living in harmony. The Indus Valley civilization provides evidence of human interest in wildlife, as seen in seals depicting images of rhino, elephant, bull, etc. Historically, conservation of nature and natural resources was an innate aspect of the Indian psyche and faith, reflected in religious practices, folklore, art and culture permeating every aspect of the daily lives of people. Scriptures and preachings that exhort reverence for nature and relate to conservation can be found in most of the religions that have flourished in the Indian subcontinent. Hinduism, Buddhism, Jainism, Christianity, Islam; and others place great emphasis on the values, beliefs, and attitudes that relate to the cross-cultural universality of respect for nature and the elements that constitute the universe. The concept of sinning against nature existed in various religious systems. Classical Indian myth is replete with similes of man in unison with the environment. Many of the rituals which to modern society may seem meaningless and superstitious were traditional strategies to preserve the intrinsic relationship between man and nature. The worship of trees, animals, forests, rivers, and the sun, and considering the earth itself as Mother Goddess, were part of the Indian tradition.

SACRED GROVES

One of the finest examples of traditional practices in India based on religious faith which has made a profound contribution to nature conservation has been the maintenance of certain patches of land or forests as "sacred groves" dedicated to

a deity or a village God, protected, and worshipped. These are found all over India, and abundantly along the Western Ghats, the west coast, and in several parts of Kerala, Karnataka, Tamil Nadu and Maharashtra. In Kerala there are hundreds of small jungles dedicated to snakes (*Sarpakavu*, *Sarpa* meaning snake, *kavu* meaning jungle). There are also Ayyappan *kavus* dedicated to Lord Ayyappa, the most famous of which, visited by millions of devotees every year, being the sacred hill of Sabarimala with an Ayyappan temple. In spite of the depletion of forests in many parts of India, some sacred groves still remain intact as oases in deserts, conserving rich biological diversity. The maintenance of sacred groves can thus be considered to be an outstanding example of a traditional practice that has contributed to forest conservation, albeit in a small measure. There are also examples of sacred ponds attached to temples in many parts of India. Some of these have been responsible for the protection of certain endangered species of turtles, crocodiles, and the rare fresh water sponge.

SACRED PLANTS AND ANIMALS

Many plants and animals have from historical times been considered sacred in India by various communities. The most outstanding examples are the peepal tree (*Ficus religiosa*). The banyan tree (*Ficus 'bengelensis*, and Khejdi tree (*Prosopis cineraria*), and these have been traditionally revered and therefore never cut. There are a number of other trees and plants considered sacred and grown in temple premises and are protected in other localities. More than a hundred such species of trees/plants in India are considered sacred by various communities and religious faiths. These include the sandalwood tree, beetlenut, palm, *neem*, coconut palm, juniper, *champa*, lotus, *tulsi*, pepper, etc. Such traditional cultural attitudes, though based on religious faith, have made significant

contribution in the protection and propagation of various species of trees and plants in India.

Many animals are considered sacred and worshipped by several Hindu and other communities and have thus received protection for centuries. The peafowl, sacred to lord Karttikeya is never hunted, the blue rock pigeon is considered sacred to Saint Hazrat Shah Lalal and is protected in the Bengal region. Even rodents are considered sacred and are allowed to breed in the famous temple of goddess Karnimata in Rajasthan. The tiger and the cobra, though greatly feared, are afforded protection on religious grounds. According to Asutosh Bhattacharya (1956): "In the pre-Aryan society of India tiger worship was in vogue from the remotest past. The seal engraved with the image of Siva, lord of beasts, that has been discovered at Mohenjodaro has also, among other four principal beasts, the figure of a tiger engraved beside Siva. Siva, the god of the ancient non-Aryan race of India, is clad in a tiger skin and it is a tiger skin which is his seat. Probably the tiger was the most primitive vehicle of Siva. Later, when cow-worship started in society, Siva was made to ride on a bullock, but a tiger skin was preserved for his wearing cloth and seat. The legitimate conclusion forms the association of this particular beast with the god Siva is that the tiger-worship of primitive society has subsequently got mixed with the Saiva cult. Another proof of the special vogue of tiger-worship in regions lying outside the pale of Aryan society in Northern India is that there is a community named Baghel Rajputs in Rajputana. Perhaps they are the descendants of some primitive community of tiger-worshippers. They worship tigers and never hunt them."

Snake worship has been an established cult among the Nairs of Kerala. Snake groves or *kavus* abounding in wild trees and creepers housing a cobra's head carved in granite were

found near the homes of many Kerala Hindus. The celebrated Padmanabaswami temple in Thiruvanthapuram has Lord Vishnu reclining on a mighty serpent. Many other animals are also worshipped as they are considered vehicles of gods and goddesses. Dealing with the status given to 'animals in India, Sadashiv Gorakshkar (1988) states: "In Buddhist mythology, the *Jatakas* or the stories of the Buddha's previous life are replete with several incarnations of the Bodhisattvas as an animal. Among the Jains, eighteen of the twenty-four Tirthankaras have an animal as their cognizance. It is interesting to observe that the first, second and the eleventh Tirthankaras have a bull, an elephant and a rhinoceros as their cognizances. Their antiquity could be traced to the Indus valley period (c. 2500 -1750 BC). The famous Pasupati seal, for instance, shows a deity seated with a horned crown and surrounded by an elephant, a tiger, a rhino and a bull/buffalo.

All these vividly show how the ancient culture and traditions of Indian society contributed to the conservation of natural ecosystems, and the plants and animals that inhabited these.

REVIEW QUESTION

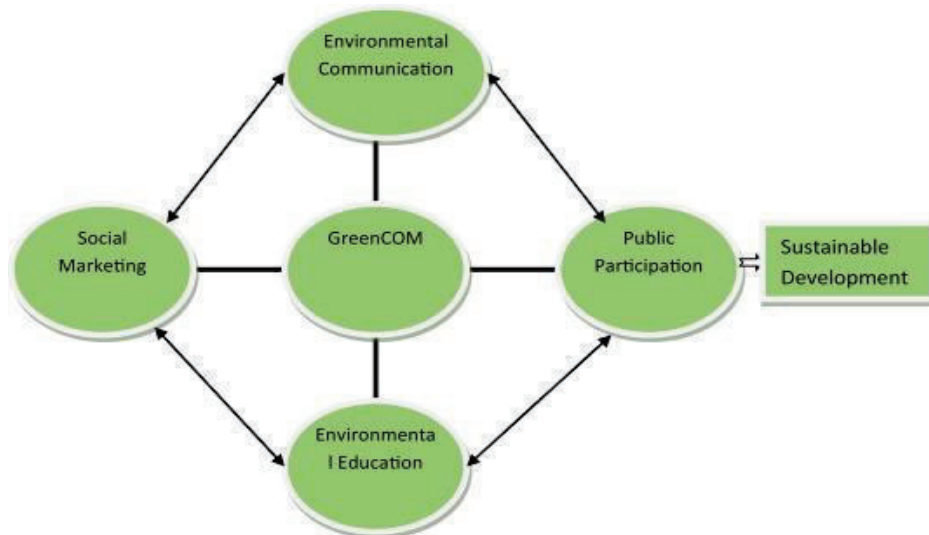
1. Discuss about the environmental ethics that are to be followed by us.

ENVIRONMENTAL COMMUNICATION AND PUBLIC AWARENESS

ENVIRONMENTAL COMMUNICATION

Environmental communication is a means of influencing public environmental awareness. It is not by default pro-environmental but rather about public relationships with nature. It appears in many different forms ranging from audio-visual to written messages. It happens on many different levels. That means it concerns the general public, academics, policy-makers or even the governments.

Environmental communication is also a type of symbolic action that serves two functions: Environmental human communication is pragmatic because it helps individuals and organizations to accomplish goals and do things through communication. Examples include educating, alerting, persuading, and collaborating. Scientifically speaking, environmental communication borrows elements of risk communication and science communication. When it comes to risk communication, it is not always linked to environmental risks. It deals with incalculable, man-made threats that we know about but don't see. Its main aim is to educate the concerned audience on how to best respond to these threats.



Environmental communication borrows the function of making science accessible. It ensures the public, media, policy makers and other audience gets access to science. An Environmental communication campaign can empower the public and raise their awareness about issues affecting them. It is influential and informative and potentially offers solutions at hand to people, businesses, or even governments. Environmental communication also matters for influencing the media by feeding broadcasting and publishing media with accessible, up-to-date information.

PUBLIC AWARENESS

Public awareness of the environment is the ability to understand the surrounding world, including understandings to all the changes occurring in the environment, understanding of cause- and-effect relationships between the quality of the environment and human behaviour, and a sense of responsibility of preserving them



Public awareness and knowledge of environmental protection are crucial to avoid environmental pollutions. Lack of relevant scientific principles and lack of public awareness of environmental or other projects are hindrances to controlling environmental pollution

CASE STUDY OF CNG

This case study explores the use of heavy-duty refuse trucks fuelled by compressed natural gas (CNG). Not very long ago in 1993, during the English cricket tour of India, when the visitors lost a match, they attributed part of their loss to the air pollution in Delhi – the capital city of India. Perhaps they were bad losers, but we must admit that the pollution levels were dangerously high enough for it to be listed amongst the world's most polluted cities. Vehicular emissions, which accounted for 70% of the air pollution, would morph into deadly smog during the foggy winters resulting in an increase in respiratory illnesses, with children and senior citizens being the worst affected. With the economy shifting gears around the same time amidst increasing middle class aspirations, with about 500 new vehicles being added every day, a turnaround seemed highly improbable.

Ever since then, Delhi has won the US Department of Energy's first 'Clean Cities International Partner of the Year' award in 2003 for "bold efforts to curb air pollution and support alternative fuel initiatives". In a unique display of judicial activism, the Supreme Court of India ordered the responsible government to switch its public-transit system to a cleaner-burning fuel in response to citizens' concerns about air pollution. Buoyed by the public pressure, the government of New Delhi reluctantly as is typical of a developing nation, complied and enforced regulations to convert its entire fleet of diesel and gasoline dependent public transport system to Compressed Natural Gas (CNG) by 2002. It's funny to note that the court actually slapped a fine of about \$450 on the Union government, for repeatedly seeking a modification in the order. To its credit, once the government set about preparing a comprehensive action plan by passing the desired legislation and setting up the infrastructure necessary for such a transition, it earned the recognition of drafting one amongst the top 12 best policies in the world, as per a study conducted by the World Wide Fund for Nature (WWF) and E3G.

Between 2000 and 2008, the Carbon emissions plummeted by 72%, while the SO₂ emissions decreased by 57% on account of 3500 CNG buses, 12000 taxis, 65000 auto rickshaws (tuk-tuks) and 5000 mini buses plying on CNG. It is mainly comprised of methane, which upon combustion mainly emits CO₂ and H₂O and being lighter disperses very quickly, whereas gasoline and diesel being more complex, emit more harmful emissions such as NO_x and SO_x. Owing to the recent volatility in the oil prices and continued patronage of CNG by the government by way of subsidies, the general public has begun to increasingly incorporate CNG kits in their private vehicles, which facilitates them to run on dual fuel mode. Encouraged by the public response, the Ministry of Petroleum and Natural Gas has set

about an ambition plan of bringing 200 cities under the supply network of CNG and Piped Natural Gas (PNG) by 2015. For a country which depends on 70% of oil imports, the recent indigenous gas discoveries in the K.G Basin and elsewhere have only brightened our outlook for lesser dependence on foreign oil, enabling us to save valuable foreign exchange. In view of growing awareness for cleaner air and climate change, there's many a lesson to be learnt from Delhi's resurgence.

REVIEW QUESTION

- 1.How to improve your environmental communication for public awareness:

UNIT 8

FIELD WORK

Field Studies and the Natural Environment

Learning outside the classroom in the natural environment can encompass a range of places or habitats, including school grounds, local parks, allotments, waste ground, hedges, walls, gardens, reserves, woodland, country parks, farmland, zoos, botanic gardens, quarries, cliffs, coastal areas, ponds, rivers, moorlands and mountains. Of course, very few, if any, of the places listed are actually natural; the majority, if not all, of the environment has been directly or indirectly affected by man in some way or another.

Learning opportunities and Learning outside the classroom in the natural environment is typically termed 'field studies'. This involves:

- Use of the environment as a resource for learning by developing investigative, enquiry and other skills
- Studying the local or wider environment to promote knowledge and understanding of the interaction between natural and human systems
- Encouraging the development of caring attitudes and values, so that each person develops a sense of responsibility for his or her actions and empathy with the environment. Local authority Local urban parks, botanical gardens and country parks may offer all you need. They are usually managed by local authorities or charitable trusts, are easily accessible and often free of charge.

Field Study and Outdoor Education Centres Run by local authorities, charitable trusts or private companies, and offering specialist or mixed programmes of activities, visits and field studies on a day or residential basis.

Fieldwork is usually concerned with careful observation, recording of information (e.g. through sketching and describing the features, patterns and processes that make up the environment). The purpose of field project work has the dual purpose of promoting the student's own learning while contributing to the development of the people with whom he / she works, especially the disadvantaged sections of our society.

Reasons to conduct environmental research

Environmental research is an interesting subject for those who have a concern for the environment and organisms on Earth. Whether it's for work, school or a hobby, there are a variety of reasons to conduct this type of research, including:

Protecting the environment

Environmental research is vital for conservation. This type of research can help to find safe practices for production and consumption to reduce the negative effects of human activity on the environment. Researching natural occurrences such as wildfires or wildlife can also help to develop preventative measures or optimize the use of natural resources such as wind and water.

Examples of environmental research topics

If we are conducting environmental research for our career or for a course we are studying, here are 15 examples of environmental research topics to consider:

1. Climate change

Climate change is the global rise in temperature and alterations in weather patterns as a result of human emissions and greenhouse gases. Since climate change affects everyone and focuses on the changes in the environment, this is a great topic for research. You can conduct research on the causes and effects of climate change or research prevention methods for corporations and individuals.

2. Renewable energy

Renewable energy comes from resources that have an unlimited or reusable supply, such as wind or the sun. Using renewable energy is one way to slow the effects of climate change because it produces low waste and pollution. If you choose renewable energy as a research topic, you might try to discover which renewable energy is best for different regions or learn how each type of renewable energy affects its environment.

3. Noise pollution

Noise pollution is exposure to high levels of sound for an extended period of time. Research questions may involve the common causes of noise pollution, how it affects organisms in the environment and how people can reduce noise pollution.

This topic of environmental research is newer and conducting studies can help improve human lives and ecosystems.

4. Conservation biology

Conservation biology is a broad topic of environmental research because it covers the management and preservation of ecosystems and organisms. With this topic, you can explore research questions such as how human activities affect biodiversity and what people can do to prevent the extinction of species in nature. Specific conservation methods you may research include breeding, blocking erosion, creating nature reserves or protecting habitats.

5. Geographical information systems

A geographical information system helps map geographic patterns. Scientists can use these systems to forecast, monitor change, identify issues and respond to geographic events. You can use this as a topic of research to report on how technology aids in predicting events in nature and how these maps can help protect the environment. This is also a good environmental research topic to perform in-depth research about different industries that use these information systems, like health care, insurance, manufacturing and communications.

6. Urban ecology

Urban ecology studies how ecological processes occur in cities and other densely populated areas. This topic may include achieving sustainability, reducing pollution and managing the Earth's population. As cities continue to grow, this is an emerging topic for environmentalists. It's important to study

how organisms interact in urban ecosystems in order to design cohabitation methods for all future life on Earth.

7. Fire ecology

Fire ecology is a study of wildfires and how they affect the environment. This topic for environmental research, you can studies about the causes of wildfires, how to prevent and manage them and their effects on the environment. If you choose to research fire ecology, may focus on three primary topics: fuel, oxygen and heat.

8. Environmental justice

Environmental justice refers to equality in developing and enforcing laws to protect and manage the environment. This is an important topic to protect the environment in all regions, regardless of the population or wealth. Research questions may involve the effects of policies in certain regions or ways policymakers can involve communities. Environmental justice also ensures that manufacturing, commercial operations and policies do not affect communities disproportionately.

9. Ecosystems

An ecosystem involves a physical environment and the relationships organisms have in that area. This is a broad topic for environmental research because you can study any location and the interactions of living organisms and nature in that environment. Understanding ecosystems is vital to conservation, which is the focus of most environmental research. As a research topic, researcher may study the importance of aspects in an ecosystem, creatures that exist in

multiple ecosystems and organisms that can only survive in certain ecosystems.

10. Endangered species

Endangered species are plants and animals that are becoming extinct. For environmental research, you can teach others about what these species are and how to protect them. Research may also include how human activity affects other species or how losing these species could be detrimental to their environments.

11. Deforestation

Deforestation is the mass loss of trees for production or land development. It can have many negative effects on ecosystems, and with environmental research, one can make others more aware of these causes and effects. Topic questions to answer in your research may include regions where deforestation has the most impact, how to repair environments where deforestation occurs and how to conserve forests. It may be helpful to discuss the benefits of forests and trees to people and animals.

12. Ozone repair

Damage to the ozone contributes to climate change, so this is an interesting topic for environmental research to explore the options for repairing or reducing the damage to the ozone layer. This is the upper atmospheric layer over the Earth, which becomes damaged from satellites and space travel. As a topic for environmental research, researcher can discuss possibilities for future space travel and launching satellites or develop solutions for how to manage the effects of having damaged ozone.

13. Water management

Water management is a study of how to manage water resources, including the oceans, lakes and groundwater. Environmental research on water management may include developing ways to optimize the use of this resource, since it is vital for all life forms. In your research, you may study how to make water clean and reusable for drinking, how to manage and distribute bodies of water or how to best use water in each of its cycles.

14. Pale ecology

Pale ecology studies organisms and their relationships throughout history. For environmental research, one can study fossils and evolution. Scientists can use the past to inform decisions about the environment now, which is a useful by-product of conducting environmental research into pale ecology.

15. Wildlife ecology

Wildlife ecology is a study of how to protect, manage and grow populations of wild animals in their natural habitats. This is a popular topic for national parks and relates to the studies of endangered species. An environmental research paper on this topic may focus on preventive measures people can take to conserve wildlife habitats, provide information on ecosystems in certain regions or explain the effects human activity has on wildlife ecology. You may choose to research a specific animal, region or effect.

General Field work:

1. Visit to local polluted site (any one)

- a) Urban: Identify the major sources of air pollution in a city or town .
- b) Rural: Analyse the major sources of organic pollution in villages and adjoining agricultural fields.
- c) Industry: Prepare a list of the large and medium industries in and around your college are and the probable pollutants they may produce.

2. Study of flora and fauna (any one)

- a) Prepare a list of the economic plants available in the college block or near your area.
- b) List the birds sighted and found nesting at the college campus and its surroundings with the season of their occurrence.
- c) Record insects associated with any common crop/grassland/tree of the college area with an idea of their habitat.

3. Visit to local area to document environmental assets (any one):

- a) Trip to any riverside system of Terrain: comment on the direction, volume and quality of water, flowing as observed.
- b) Record the nature of vegetation/forest type/land use pattern at the site of visit.

c) Analyse the cause of deforestation and landslide on hill slope, if sighted.

4. Study of ecosystems. (any one)

a) Pond: water parameters – turbidity, pH, producers (photo and zooplanktons) and related consumers (fishes and birds).

b) Grassland on hill slope: producers (plants), insects, consumers (birds, mammals, reptiles etc.) c) Forest: practical concept of forest type, stories, dominant trees and sub – dominant vegetation, observed and reported major herbivores and carnivores in a forest ecosystem.