ELECTIVE COURSE 3 (EC 3): ENVIRONMENTAL EDUCATION. B.ED. SEM - 4

COMPILED GREY NOTES

INDEX

Unit 1 : Concept of Environment, Ecosystem and Ecology

a) Environment : Meaning , components (Biotic and Abiotic)

Meaning and Definition:

The term environment has been derived from a French word “Environia” means to surround. It refers to both abiotic (physical or non-living) and biotic (living) environment. The word environment means surroundings, in which organisms live. Environment and the organisms are two dynamic and complex components of nature. Environment regulates the life of the organisms including human beings. Human beings interact with the environment more vigorously than other living beings. Ordinarily environment refers to the materials and forces that surrounds the living organism.

Environment is the sum total of conditions that surrounds us at a given point of time and space. It is comprised of the interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively. Environment is the sum total of conditions in which an organism has to survive or maintain its life process. It influences the growth and development of living forms.

In other words environment refers to those surroundings that surrounds living beings from all sides and affect their lives in toto. It consists of atmosphere, hydrosphere, lithosphere and biosphere. It’s chief components are soil, water, air, organisms and solar energy. It has provided us all the resources for leading a comfortable life.

1. According to P. Gisbert “Environment is anything immediately surrounding an object and exerting a direct influence on it.”

2. According to E. J. Ross “Environment is an external force which influences us.”

Thus, environment refers to anything that is immediately surrounding an object and exerting a direct influence on it. Our environment refers to those thing or agencies which though

distinct from us, affect our life or activity. The environment by which man is surrounded and affected by factors which may be natural, artificial, social, biological and psychological.

The environment is defined as the whole physical and biological system surrounding man and other organisms along with various factors influencing them. The factors are soil, air, water, light, temperature etc. These are called Abiotic factors. Besides the abiotic factors, the environment is very much influenced by biotic factors which include all forms of life like plants, animals, microorganisms etc.Man is thus an inseparable part of the environment. Man and Environment have very close relationship with each other. The social life of man is affected by environment. This is the reason for various types of social and cultural activities around the world. The hilly people have different life styles than people in the plain area. Similarly people around the world differ in their food, cloth, festivals etc. All these are influenced by the factors around him.

The environment has three important constituents. These are:

(a) Physical

(b) Biological

(c) Social

(a) The Physical Constituent of environment includes soil, water, air, climate, temperature, light etc. These are also called abiotic constituents of the environment. This part of the environment mainly determines the type of the habitat or living conditions of the human population. This physical constituent of the environment is again divided into three parts.

These are:

(i) Atmosphere (gas)

(ii) Hydrosphere (liquid)

(iii) Lithosphere (solid)

These three parts represent the three important states of matter constituting the environment. This physical component of environment only consists of non-living things like air, water and soil. All these non-living things influence much to all living organisms including man. Water and temperature are the most important abiotic components affecting living beings. Larger proportion of body's weight is due to water.

All living organisms require water for their survival. Besides water is the main vital fluid to keep optimum temperature of the body. All life activates work in a particular range of temperature. When temperature will be in excess of necessity, living beings will die.

Air is main physical component which provides oxygen for respiration. All living beings including plants & animals require oxygen for their existence. Oxygen is taken into the body by respiration process and comes out in from of carbon dioxide. Plants, on the other hand takes in carbon dioxide for food preparation during photosynthesis and gives out oxygen to the surrounding.

Soil is the most important for all living beings to create their habitat. It is the soil in which plant grows and man constructs houses to live in. It is the ground water present in the soil which provides for drinking and other farming activities.

(b) The biological constituent of environment is also called biotic component of environment. This component consists of all living things like plants, animals and small micro-organisms like bacteria. This component interacts with the abiotic component of the environment. This interaction of two components forms various ecosystems like pond ecosystem, marine ecosystem, desert ecosystem etc.

c) The social constituent of environment mainly consists of various groups of population of different living organisms like birds, animals etc. Man is the most intelligent living organism. Like other living creatures, man builds house, prepares food and releases waste materials to the environment. Man is a social animal as told by Greek philosopher, Aristotle. He makes various laws, policies for the proper functioning of the society.

Abiotic factors refer to non-living physical and chemical elements in the ecosystem. Abiotic resources are usually obtained from the lithosphere, atmosphere, and hydrosphere. Examples of abiotic factors are water, air, soil, sunlight, and minerals.

Biotic factors are living or once-living organisms in the ecosystem. These are obtained from the biosphere and are capable of reproduction. Examples of biotic factors are animals, birds, plants, fungi, and other similar organisms.

Comparison chart

	Abiotic	Biotic
Definition	Any non living or physical factor	Any living or biological factor
Introduction	In ecology and biology, abiotic components are non-living chemical and physical factors in the environment which affect ecosystems.	Biotic describes a living component of an ecosystem; for example organisms, such as plants and animals
Examples	Water, light, wind, soil, humidity, minerals, gases.	All living things — autotrophs and heterotrophs — plants, animals, fungi, bacteria.
Affects	Affect the ability of organisms to survive, reproduce; help determine types and numbers of organisms able to exist in environment; limiting factors restrict growth.	Living things that directly or indirectly affect organisms in environment; organisms, interactions, waste; parasitism, disease, predation.
Factors	Individual of a species, population, community, ecosystem, biome, biosphere.	Individual of a species, population, community, ecosystem, biome, biosphere.

b) Concept of Ecosystem, Types of Eco system

What is Eco system

An ecosystem, a term very often used in biology, is a community of plants and animals interacting with each other in a given area, and also with their non-living environments. The non-living environments include weather, earth, sun, soil, climate and atmosphere.

The ecosystem relates to the way that all these different organisms live in close proximity to each other and how they interact with each other. For instance, in an ecosystem where there are both rabbits and foxes, these two creatures are in a relationship where the fox eats the rabbit in order to survive. This relationship has a knock on effect with the other creatures and plants that live in the same or similar areas. For instance, the more rabbits that foxes eat, the more the plants may start to thrive because there are fewer rabbits to eat

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Concept of Eco System:

•"Ecosystem can be defined as a particular category of physical systems, consisting of organisms and inorganic components in a relatively stable equilibrium, open and of various sizes and kinds." – Sir Arthur. G Tansley (1935)

•"The ecosystem involves the circulation, transformation and accumulation of energy and matter through the medium of living organisms and their activities." – Evans (1956)

•The word ecosystem is not a synonym of habitat, community or some other similar descriptive terms. Rather, it is a technical term in ecology and refers to "a system of living and non-living components interacting as a whole."

Types of Eco System

There are essentially two kinds of ecosystems; Aquatic and Terrestrial. Any other sub-ecosystem falls under one of these two headings.

Terrestrial ecosystems

Terrestrial ecosystems can be found anywhere apart from heavily saturated places. They are broadly classed into:

The Forest Ecosystems

They are the ecosystems in which an abundance of flora, or plants, is seen so they have a big number of organisms which live in relatively small space. Therefore, in forest ecosystems the density of living organisms is quite high. A small change in this ecosystem could affect the whole balance, effectively bringing down the whole ecosystem. You could see a fantastic diversity in the fauna of the ecosystems, too. They are further divided into:

Tropical evergreen forest: These are tropical forests that receive a mean rainfall of 80 for every 400 inches annually. The forests are characterised by dense vegetation which comprises tall trees at different heights. Each level is shelter to different types of animals.

Tropical deciduous forest: There, shrubs and dense bushes rule along with a broad selection of trees. The type of forest is found in quite a few parts of the world while a large variety of fauna and flora are found there.

Temperate evergreen forest: Those have quite a few number of trees as mosses and ferns make up for them. Trees have developed spiked leaves in order to minimize transpiration.

Temperate deciduous forest: The forest is located in the moist temperate places that have sufficient rainfall. Summers and winters are clearly defined and the trees shed the leaves during the winter months.

Taiga: Situated just before the arctic regions, the taiga is defined by evergreen conifers. As the temperature is below zero for almost half a year, the remainder of the months, it buzzes with migratory birds and insects.

The Desert Ecosystem

Desert ecosystems are located in regions that receive an annual rainfall less than 25. They occupy about 17 percent of all the land on our planet. Due to the extremely high temperature, low water availability and intense sunlight, fauna and flora are scarce and poorly developed. The vegetation is mainly shrubs, bushes, few grasses and rare trees. The stems and leaves of the plants are modified in order to conserve water as much as possible. The best known desert ones are the succulents such as the spiny leaved cacti. The animal organisms include insects, birds, camels, reptiles all of which are adapted to the desert (xeric) conditions.

The Grassland Ecosystem

Grasslands are located in both the tropical and temperate regions of the world though the ecosystems vary slightly. The area mainly comprises grasses with a little number of trees and shrubs. The main vegetation includes grasses, plants and legumes that belong to the composite family. A lot of grazing animals, insectivores and herbivores inhabit the grasslands. The two main kinds of grasslands ecosystems are:

Savanna: The tropical grasslands are dry seasonally and have few individual trees. They support a large number of predators and grazers.

Prairies: It is temperate grassland, completely devoid of large shrubs and trees. Prairies could be categorized as mixed grass, tall grass and short grass prairies.

The Mountain Ecosystem

Mountain land provides a scattered and diverse array of habitats where a large number of animals and plants can be found. At the higher altitudes, the harsh environmental conditions normally prevail, and only the treeless alpine vegetation can survive. The animals that live there have thick fur coats for prevention from cold and hibernation in the winter months. Lower slopes are commonly covered with coniferous forests.

Aquatic Ecosystems

The aquatic ecosystem is the ecosystem found in a body of water. It encompasses aquatic flora, fauna and water properties, as well. There are two main types of aquatic ecosystem - Marine and Freshwater.

The Marine Ecosystem

Marine ecosystems are the biggest ecosystems, which cover around 71% of Earth's surface and contain 97% of out planet's water. Water in Marine ecosystems features in high amounts minerals and salts dissolved in them. The different divisions of the marine ecosystem are:

Oceanic: A relatively shallow part of oceans which lies on the continental shelf.

Profundal: deep or Bottom water.

Benthic Bottom substrates.

Inter-tidal: The place between low and high tides.

Estuaries

Coral reefs

Salt marshes

Hydrothermal vents where chemosynthetic bacteria make up the food base.

Many kinds of organisms live in marine ecosystems: the brown algae, corals, cephalopods, echinoderms, dinoflagellates and sharks.

The Freshwater Ecosystem

Contrary to the Marine ecosystems, the freshwater ecosystem covers only 0.8% of Earth's surface and contains 0.009% of the total water. Three basic kinds of freshwater ecosystems exist:

Lentic: Slow-moving or till water like pools, lakes or ponds.

Lotic: Fast-moving water such as streams and rivers.

Wetlands: Places in which the soil is inundated or saturated for some lenghty period of time.

The ecosystems are habitats to reptiles, amphibians and around 41% of the world’s fish species. The faster moving turbulent waters typically contain a greater concentrations of dissolved oxygen, supporting greater biodiversity than slow moving waters in pools.

c) Concept of Ecology, Ecological Pyramids (Numbers, Mass, Energy), Food Web & Ecological Energy Dynamics

Concept of Ecology

- **Ecology** is the study of how organisms interact with one another and with their physical environment.
- The distribution and abundance of organisms on Earth is shaped by both **biotic**, living-organism-related, and **abiotic**, nonliving or physical, factors.
- Ecology is studied at many levels, including organism, population, community, ecosystem, and biosphere.
- The word *ecology* was coined by the German zoologist Ernst Haeckel, The word comes from the Greek *oikos*, meaning "household," "home," or "place to live."

A conceptual understanding of ecology is found in the broader details of study, including:

- Life processes explaining adaptations
- Distribution and abundance of organisms
- The movement of materials and energy through living communities
- The successional development of ecosystems, and
- The abundance and distribution of biodiversity in context of the environment.

Ecological Pyramids (Numbers, Mass, Energy):

- Ecosystem comprises of various trophic levels and these are called producers (autotrophs), primary consumers (herbivores), secondary consumers (primary carnivores), and tertiary consumers (top consumers or top carnivores).
- Food energy passes from one trophic level to another trophic level, and in each transfer much of its energy is lost as heat and as such each trophic level receives less energy as compared to previous trophic level. The energy level in the food chain thus gradually tapers, forming a pyramid like structure.
- The graphic representation of relationship between the various trophic levels of a food chain is called as **Ecological Pyramid**.
- The concept of ecological pyramid was developed by Charles Elton

There are 3 types of ecological pyramids as described as follows:

- Pyramid of numbers
- Pyramid of biomass.
- Pyramid of energy

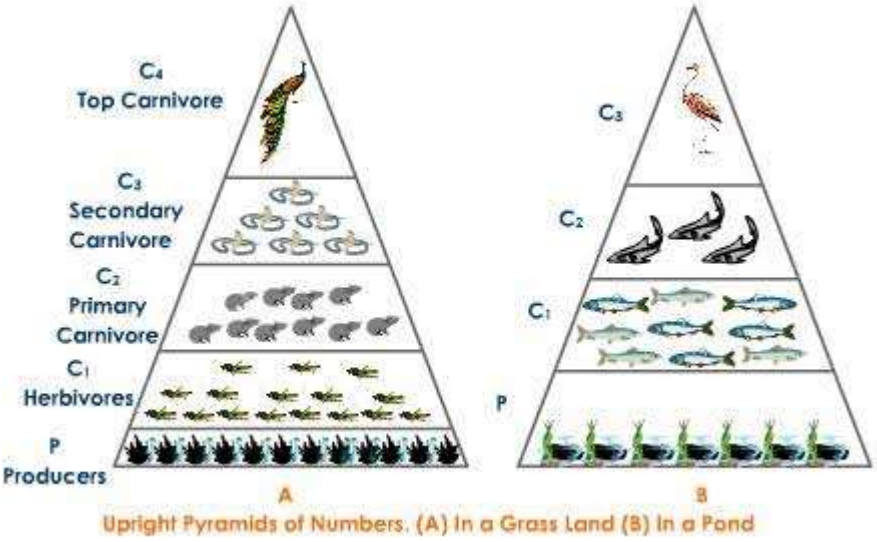
Ecological Pyramid of Numbers

The pyramid of numbers depicts the relationship in terms of the number of producers, herbivores and the carnivores at their successive trophic levels. There is a decrease in the number of individuals from the lower to the higher trophic levels. The number pyramid varies from ecosystem to ecosystem. There are three of pyramid of numbers:

- Upright pyramid of number
- Partly upright pyramid of number and
- Inverted pyramid of number.

Upright Pyramid of Number

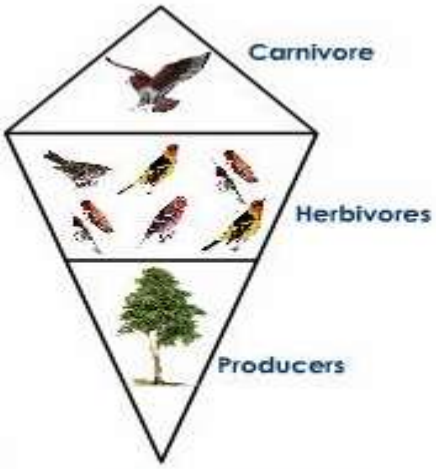
This type of pyramid number is found in the aquatic and grassland ecosystem, in these ecosystems there are numerous small autotrophs which support lesser herbivores which in turn support smaller number of carnivores and hence this pyramid is upright.



Upright Pyramids of Numbers. (A) In a Grass Land (B) In a Pond

Partly Upright pyramid of Number

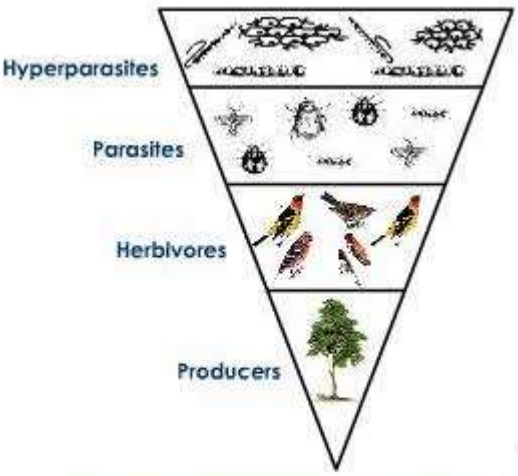
It is seen in the forest ecosystem where the number of producers are lesser in number and support a greater number of herbivores and which in turn support a fewer number of carnivores.



Partly Upright Pyramid of Number

Inverted Pyramid of Number

This type of ecological pyramid is seen in parasitic food chain where one primary producer supports numerous parasites which support more hyperparasites.



Inverted pyramid of number

Ecological Pyramid of Biomass

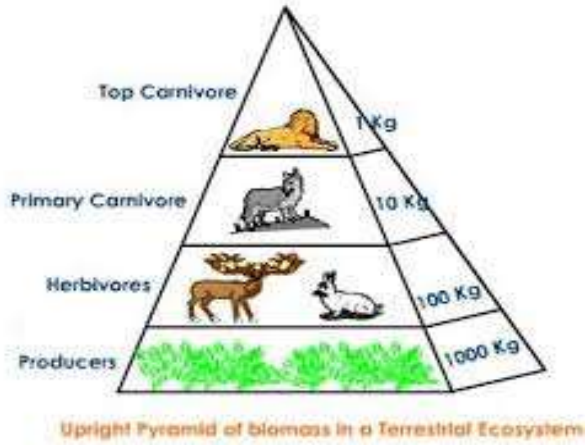
The pyramid of biomass is more fundamental, they represent the quantitative relationships of the standing crops. In this pyramid there is a gradual decrease in the biomass from the producers to the higher trophic levels. The biomass here the net organisms collected from each feeding level and are then dried and weighed. This dry weight is the biomass and it represents the amount of energy available in the form of organic matter of the organisms. In this pyramid the net dry weight is plotted to that of the producers, herbivores, carnivores, etc.

There are two types of pyramid of biomass, they are:

- Upright pyramid of biomass and
- Inverted pyramid of biomass.

Upright Pyramid of Biomass

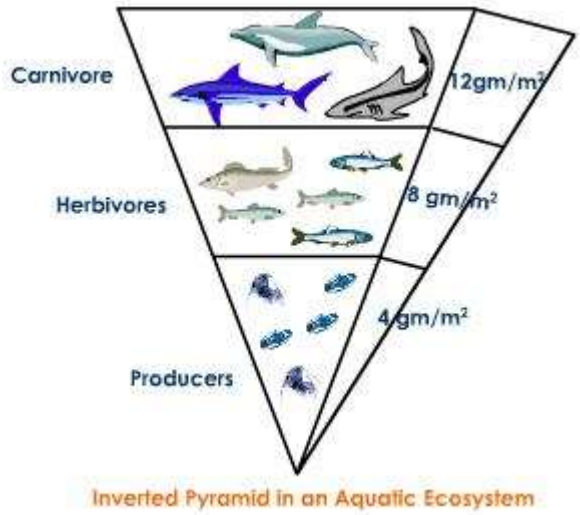
This occurs when the larger net biomass of producers support a smaller weight of consumers.
Example: Forest ecosystem.



Upright Pyramid of biomass in a Terrestrial Ecosystem

Inverted Pyramid of Biomass

This happens when the smaller weight of producers support consumers of larger weight.
Example: Aquatic ecosystem.

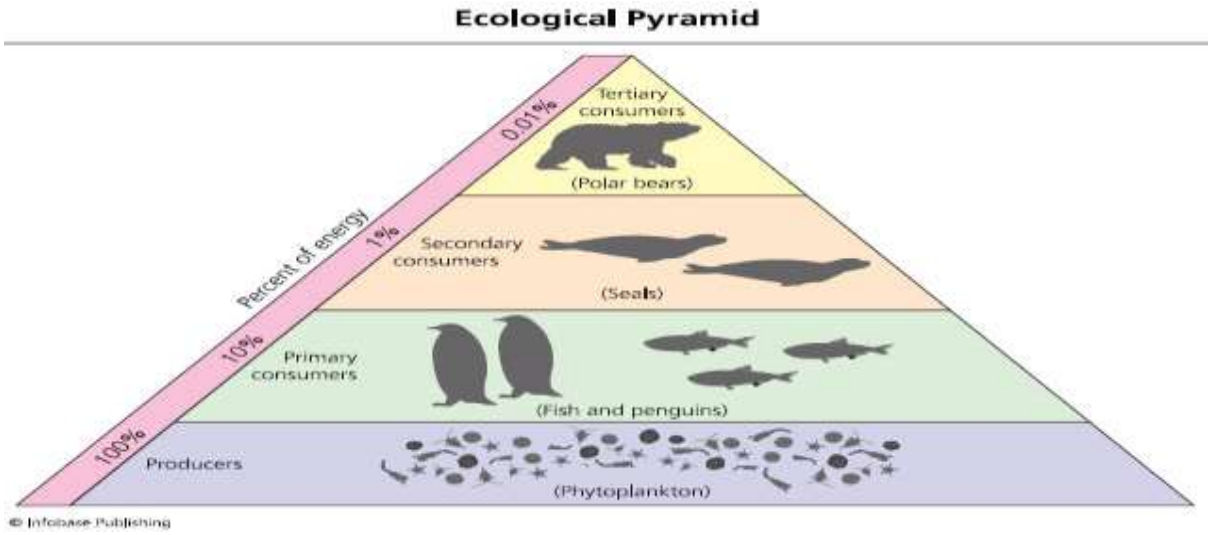


Inverted Pyramid in an Aquatic Ecosystem

Ecological Pyramid of Energy

The pyramid of energy or the energy pyramid describes the overall nature of the ecosystem. During the flow of energy from organism to other, there is considerable loss of energy in the form of heat. The primary producers like the autotrophs there is more amount of energy available. The least energy is available in the tertiary consumers. Thus, shorter food chain has more amount of energy available even at the highest trophic level.

- The energy pyramid always upright and vertical.
- This pyramid shows the flow of energy at different trophic levels.
- It depicts the energy is minimum as the highest trophic level and is maximum at the lowest trophic level.
- At every trophic level organisms use the energy from the previous trophic level for its own growth and metabolism while some amount of energy is lost to the environment in the form of heat. Thus the energy transfer is never 100%.



Function of Ecological Pyramid

An ecological pyramid not only shows us the feeding patterns of organisms in different ecosystems, but can also give us an insight into how inefficient energy transfer is, and show

the influence that a change in numbers at one trophic level can have on the trophic levels above and below it. Also, when data are collected over the years, the effects of the changes that take place in the environment on the organisms can be studied by comparing the data. If an ecosystem's conditions are found to be worsening over the years because of pollution or overhunting by humans, action can be taken to prevent further damage and possibly reverse some of the present damage.

Limitations of Ecological Pyramids

While the three ecological pyramids are highly specific to the aspect of ecosystem they want to describe, all of them still tend to overlook important aspects. Some of these limitations are the following:

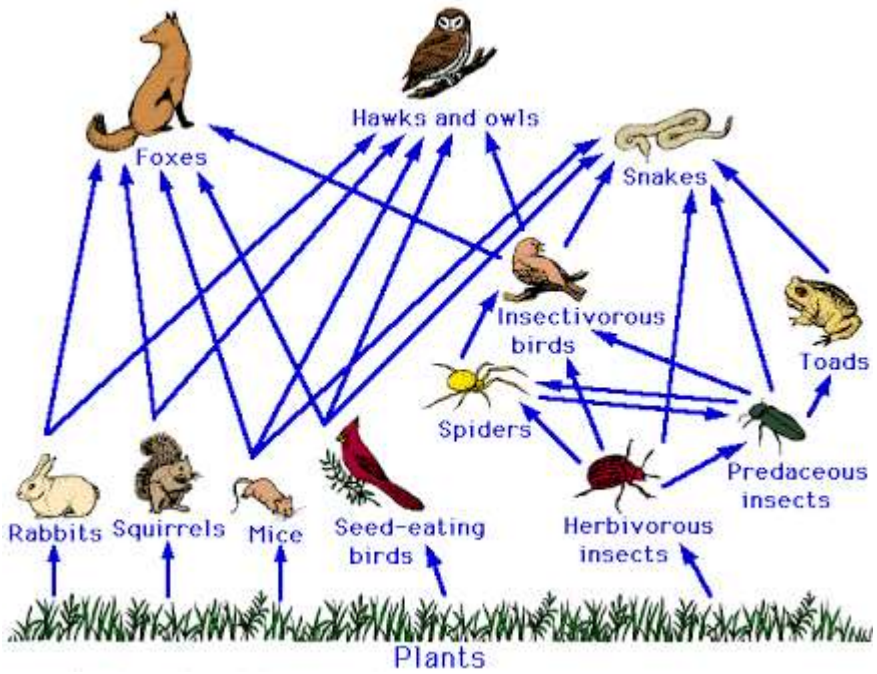
- These types of pyramids only are applicable in simple food chains (and not food webs), which do not necessarily occur naturally. They also do not consider the possible presence of the same species at different trophic levels.
- Moreover, none of the three ecological pyramids provide any idea related to variations in seasons and climates.
- Other organisms like **microorganisms** and **fungi** are not given specific role in the pyramids despite their vital roles in ecosystems.

Food Web:

In natural environment or an ecosystem, the relationships between the food chains are inter-connected. These relationships are very complex, as one organism may be a part of multiple food chains. Hence, a web like structure is formed in place of a linear food chain. The web like structure if formed with the interlinked food chain and such matrix that is interconnected is known as a food web.

Food webs are an indispensable part of an ecosystem; these food webs allows an organism to obtain food from more than one type of organism of the lower trophic level. Every living being is responsible and is a part of multiple food chains in the given ecosystem. It is also referred to as a consumer-resource system.

An animal ecologist pioneer Charles Elton (1927) introduced the food web concept which he referred to as food cycle. Charles Elton described the concept of food web as: The carnivore animals prey upon the herbivores. These herbivores get the energy from sun-light. The later carnivores may also be preyed upon by other carnivores. Until a reach where an animal has no enemies it forms a terminus on this food cycle. There are chains of animals that are linked together by food, and all are dependent on plants in the long run. This is referred to as a food chain and all the food chains in a community is known as the food cycle.



Trophic Levels

- Food webs have trophic levels and trophic positions.
- Species of plants form the first level basal species. The basal species are also known as producers; these are resources species on which the primary consumers or primary predators feed on in the web.
- These primary predators do not feed on any other living creature other than the primary producers in the food web.
- The basal species can either consists of the autotrophs or the detritivores that also includes decomposing organic material and associated microorganisms and plant material.
- Autotrophs capture energy form sun-light and produce energy by the process of photosynthesis. Others get energy chemical oxidation of inorganic compounds.
- In the top level are the apex predatores or the secondary predators, these species are not directly killed for its food resources.
- The intermediate trophic levels are filled with omnivorous species which feed on more than one trophic level and they cause the flow of energy through various food pathways from the basal species.
- The scheme of the tropic levels is such that the first trophic level consists the plants (level 1) and then the primary consumers or herbivores (level 2) and then the carnivores or secondary consumers (level 3). The detritivores are considered at the zero level of the food chain.

Ecological energy dynamics:

Laws of Thermodynamics

Two fundamental physical laws of energy are important when looking at ecological systems from an energy point of view.

- First law of thermodynamics:

"Energy may be transformed from one form to another but is neither created nor destroyed."

- Second law of thermodynamics:

"No process involving an energy transformation will occur spontaneously unless there is a degradation of energy from a concentrated to a dispersed form."

(In other words, transformation of energy is not 100% efficient.)

- It thus indicates presence of two kinds of energy in our ecological system:

a) *'Unavailable Energy'* – degraded energy not available for work

b) *'Available Energy'* – energy available to do work

- When an ecological system is young, the major flow of energy is directed towards its **'Productivity'**. But as the complexity of the system rises, the greater proportion of the **'Available Energy'** in the system, instead of directing towards its productivity is shifted more towards maintaining the complex structure that has been created.
- Eventually such a complex and matured system is seen to be associated with a tremendous **'Loss of Energy'**.
- In brief, more complex system is associated with a limited 'Available Energy' that will delimit or restrict its further development.
- Another factor associated with environmental energy-dynamics is the progressive loss of energy due to transfer of energy.
- More the phases of energy-transfer, energy-loss associated is also seen to be more.
- High energy-loss in more complex systems is therefore attributed to this factor also.
- The same principle is seen in ecological food-chains too. As we move higher from lower trophic levels to higher trophic levels, the proportion of 'Usable' energy goes on decreasing.

Progressive Loss of Energy in Food Chain

Unit 2: Major Environmental Issues : Meaning Causes Effects and Remedies

a) Climate change and loss of Biodiversity

What is Climate Change?

- **Climate change** is a change in the statistical distribution of weather patterns that lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions, defined by the World Meteorological Organization as 30 years or longer.

Causes of Climate Change:

- Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics and volcanic eruptions. Certain human activities have been identified as primary causes of ongoing climate changes, often referred to as global warming
- Factors that can shape climate are called climate forcing or "forcing mechanisms". These can be either "internal" or "external". Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermohaline circulation). External forcing mechanisms can be either anthropogenic—caused by humans—(e.g. increased emissions of greenhouse gases and dust) or natural (e.g., changes in solar output, the earth's orbit, volcano eruptions).
- In the atmosphere, gases such as water vapour, carbon dioxide, ozone, and methane act like the glass roof of a greenhouse by trapping heat and warming the planet. These gases are called greenhouse gases. The natural levels of these gases are being supplemented by emissions resulting from human activities, such as the burning of fossil fuels, farming activities and land-use changes. As a result, the Earth's surface and lower atmosphere are warming, and this rise in temperature is accompanied by many other changes.

What is Biodiversity?

The variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.

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

Change of Biodiversity:

- **In the last 100 years average global temperature has increased by 0.74°C, rainfall patterns have changed, and the frequency of extreme events increased. Change has not been uniform on either a spatial or temporal scale and the range of change, in terms of climate and weather, has also been variable.**
- **Change in climate has consequences on the biophysical environment such as changes in the start and length of the seasons, glacial retreat, decrease in Arctic sea ice extent and a rise in sea level. These changes have already had an observable impact on biodiversity at the species level, in term of phenology,**

distribution & populations, and ecosystem level in terms of distribution, composition & function.

- In general, many species have expanded their ranges poleward in latitude and upward in elevation. Evidence of contraction in species' distribution is limited, however, possibly due to reporting difficulties and time lag in such contractions due to a wide variety of possible mechanism such as population dynamics. At the species level, changes observed that can be attributed to climate change involve those surrounding phenology (the timing of events). Many birds and insects are showing changes, such as earlier onset of migration, egg-laying and breeding. In terms of ecosystems, there has been some evidence on changes in distribution. e.g. desert ecosystems have expanded, and tree lines in mountain systems have changed. Changes in the composition of ecosystems have also been observed (e.g. increased lianas in tropical forest). Such changes may affect ecosystem function and the ecosystem services they provide. Changes in biodiversity and ecosystem services due to climate change are not all negative, with some species either thriving or adapting.

- Rising levels of greenhouse gases are already changing the climate. According to the Intergovernmental Panel on Climate Change (IPCC) Working Group I (WGI) Fourth Assessment Report, from 1850 to 2005, the average global temperature increased by about 0.76ºC and global mean sea level rose by 12 to 22 cm during the last century. These changes are affecting the entire world, from low-lying islands in the tropics to the vast polar regions.
- Climate change predictions are not encouraging; according to the IPCC WGI Fourth Assessment Report, a further increase in temperatures of 1.4°C to 5.8°C by 2100 is projected. Predicted impacts associated with such temperature increase include: a further rise in global mean sea level, changes in precipitation patterns, and more people at risk from dangerous "vector-borne diseases" such as malaria.

Links between biodiversity and climate change

- There is ample evidence that climate change affects biodiversity. According to the Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Climate change is already forcing biodiversity to adapt either through shifting habitat, changing life cycles, or the development of new physical traits.
- Conserving natural terrestrial, freshwater and marine ecosystems and restoring degraded ecosystems (including their genetic and species diversity) is essential for the overall goals of both the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change because ecosystems play a key role in the global carbon cycle and in adapting to climate change, while also providing a wide range of ecosystem services that are essential for human well-being and the achievement of the Millennium Development Goals.
- Biodiversity can support efforts to reduce the negative effects of climate change. Conserved or restored habitats can remove carbon dioxide from the atmosphere, thus helping to address climate change by storing carbon (example: reducing emissions from deforestation and forest degradation). Moreover, conserving in-tact ecosystems, such as mangroves, for example, can help reduce the disastrous impacts of climate change such as flooding and storm surges.

- Changes to ecosystems as a result of climate change are likely to have significant and often negative social, cultural and economic consequences. However, there is still

uncertainty about the extent and speed at which climate change will impact biodiversity and ecosystem services, and the thresholds of climate change above which ecosystems are irreversibly changed and no longer function in their current form. Tipping points are points at which a system passes from one steady state to another. These are used for either climate tipping points or ecosystem tipping points. An example of the latter is Amazon forest dieback.

Tools to detect change

- Physical evidence to observe climate change includes a range of parameters. Global records of surface temperature are available beginning from the mid-late 19th century. For earlier periods, most of the evidence is indirect—climatic changes are inferred from changes in proxies, indicators that reflect climate, such as ice cores, dendrochronology, sea level change, and glacial geology. Other physical evidence includes arctic sea ice decline, cloud cover and precipitation, vegetation, animals and historical and archaeological evidence.
- Scientists are actively working to understand past and future climate using observations and theoretical models. A climate record extending deep into the Earth's past—has been assembled, and continues to be built up, based on geological evidence from borehole temperature profiles, cores removed from deep accumulations of ice, floral and faunal records, glacial and periglacial processes, stable-isotope and other analyses of sediment layers, and records of past sea levels.
- There are several methods and tools to assess the impact of climate change on biodiversity and ecosystem services. Climate envelope modelling is by far the most common tool used to assess potential impacts (and to infer vulnerability) on species. Although these suffer a number of limitations, they do provide a first cut assessment of the likely magnitude and direction of change. Dynamic models, population models and mechanistic models are other modelling tools that have been used to assess future impact and vulnerability on both species and ecosystems, though ecosystem service modelling is still in its infancy. These latter models need to become more prominent as climate envelop modelling mainly provide species exposure to climate change and thus only one facet of vulnerability. Indeed, vulnerability is defined as a function of exposure, sensitivity and adaptive capacity.

Conclusion:

Conserved or restored habitats can remove carbon dioxide from the atmosphere, thus helping to address climate change by storing carbon (Example: reducing emissions from deforestation and forest degradation). Moreover, conserving in-tact ecosystems, such as mangroves, for example, can help reduce the disastrous impacts of climate change such as flooding and storm surges.

b) **Bio magnification and Eutrophication**

Biological magnification is the process by which the level of concentration of toxic compound increases and accumulates along a food chain into higher levels while eutrophication is the process by which the excessive growth of algae occurs due to release of nutrients including nitrates and phosphates into water bodies in larger quantities.

What is Eutrophication?

Eutrophication is a process which occurs due to the excessive release of nutrients into water bodies. Nutrient enrichment develops due to excessive release of fertilizers including nitrates and phosphates, industrial and domestic sewage effluents, detergents, etc. This leads to the uncontrollable growth of algae (algal bloom). This excessive algal growth leads to different harmful phenomena. Since the algae grow excessively, it blocks the penetration of sunlight to the bottom of the water bodies. This leads to the death of different plants including algae due to the insufficiency of sunlight for photosynthesis. Death of plants leads to microbial decomposition. Decomposing microorganisms act on the dead plant matter which converts the organic nutrients into inorganic forms. Decomposing dead plant matter leads to the release of different toxic materials to water. Due to the activity of decomposing microorganisms in larger scale, the BOD (biological oxygen demand) level of water increases.

. BOD is the amount of dissolved oxygen in water needed for decomposing microorganisms to convert organic matter into inorganic matter. Due to the insufficient oxygen levels in water and presence of toxic compounds, lead to the death of fish and shellfish. Due to this phenomena, the activity of decomposing microorganisms increases further which leads to the formation of more toxic compounds and release of bad odor. The other animals including humans which interacts with eutrophic water bodies are also getting affected. Eutrophication occurs mainly due to human activities such as excessive usage of fertilizers which leach to water bodies and release of domestic and industrial waste effluents including sewage and detergents. Accumulation of excess nitrates and phosphates present in waste effluents and fertilizers are the major cause for eutrophication. This also leads to the decrement of the aesthetic value of a water body.

What is Biological Magnification?

Biological magnification is a process by which the concentration of persistent chemicals accumulates and increases in tissues of organisms in separate higher levels of a food chain. The accumulation and increment of toxic chemicals along a food chain may occur due to different phenomena; persistence (inability of substances to catabolized by different environmental processes, energy of the food chain (progressive increment of concentration of substances when moves along the food chain to higher levels) and due to the inability of degradation and excretion of substances which occur mainly due to water insolubility. The major types of pollutants which magnify and cause these phenomena are POP s (Persistent Organic Pollutants). They are compounds that persist in the environment and cause adverse effects to animals including humans due to its accumulation along food chains. POP s mainly

consist of chemicals such as DDT; a pesticide, PCBs (Polychlorinated Biphenyls); an industrial chemical effluent, dioxins, and furans; unintentional industrial by-products.

What is the Similarity Between Eutrophication and Biological Magnification?

- Both processes occur due to environmental pollution and affect both animals and humans adversely.

What is the Difference Between Eutrophication and Biological Magnification?

Eutrophication vs Biological Magnification	
Eutrophication is the process in which excessive growth of algae occurs due to the enrichment of water bodies by nitrates and phosphates in larger quantities that affect different levels within the water body.	Biological magnification is a process by which the concentration of POPs accumulates and increases in tissues of organisms in separate higher levels of a food chain.
Related Chemicals	
Nitrates, phosphates are responsible for eutrophication.	DDT, PCB, dioxins, furans are responsible for biological magnification.
Effects	
Algal bloom, the release of toxins due to decomposition and increase in BOD happen due to eutrophication.	Accumulation of toxic chemicals along the food chains up to the highest level happen due to biological magnification.

Summary – Eutrophication vs Biological Magnification

Human activities lead to the pollution of the environment. Eutrophication and Biological magnification are two processes which occur due to environmental pollution. Eutrophication causes algal blooms due to the enrichment of water bodies by nitrates and phosphates in larger quantities that affect different levels within the water body. Biological magnification is a process by which the concentration of POPs accumulates and increases in tissues of organisms in separate higher levels of a food chain. This is the difference between eutrophication and biological magnification. Both processes have detrimental effects on both animals and humans.

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c) **Genetic Engineering and Urban Srawl**

Intro: Humans have altered the genomes of species for thousands of years through selective breeding or artificial selection as contrasted with natural selection. Genetic engineering is the direct manipulation of DNA by humans. It has existed since the 1970s.

The term "genetic engineering" was first coined by Jack Williamson in his science fiction novel *Dragon's Island*, published in 1951 two years before James Watson and Francis Crick showed that the DNA molecule has a double-helix structure.

In 1976, **Genentech**, the first genetic engineering company, was founded by Herbert Boyer and Robert Swanson

Definition:

1. Group of applied techniques of **genetics** and **biotechnology** used to cut up and join together **genetic material**, especially DNA from one or more species of organism and to introduce the result into an organism in order to change one or more of its **characteristics**.
2. The artificial manipulation, modification, and recombination of DNA or other nucleic acid molecules in order to modify an organism or population of organisms.
3. Genetic engineering is a process that alters the genetic structure of an organism by either removing or introducing DNA.

- Unlike traditional animal and plant breeding, genetic engineering takes the gene directly from one organism and inserts it in the other. This is much faster and can be used to insert any genes from any organism and prevents other undesirable genes from also being added.
- The DNA can be introduced directly into the host organism or into a cell that is then fused or hybridised with the host. This results in formation of new combinations of heritable genetic material followed by the incorporation of that material either indirectly through a **vector** system or directly through **micro-injection**, **macro-injection** or **micro-encapsulation**.
- Plants, animals or micro organisms that have been changed through genetic engineering are termed **genetically modified organisms or GMOs.**
- If genetic material from other species is added to the host, the resulting organism is called **transgenic**.
- If genetic material from the same species or a species that can naturally breed with the host is used the resulting organism is called **cisgenic**.
- If genetic engineering is used to remove genetic material from the target organism the resulting organism is termed a **knockout** organism.

Applications:x

- Through recombinant DNA techniques, bacteria have been created that are capable of synthesizing human **insulin**, human growth **hormone**, alpha **interferon**, a hepatitis B **vaccine**, and other **medically** useful substances.
- Plants may be genetically adjusted to enable them to fix **nitrogen**, make them productive, nutritious and disease resistant without the use of chemical fertilizers. Eg: transgenic tobacco, cotton, potato etc
- Genetic diseases can possibly be corrected by replacing dysfunctional genes with normally functioning genes through **gene therapy**. Eg: Gene therapy is used for cystic fibrosis, muscular dystrophy etc.
- It can be used to monitor the **degradation** of garbage, petroleum products, naphthalene and other **industrial** wastes. A variety of organic chemicals can be synthesised at large scale with the help of genetically engineered microorganisms. Eg:

Glucose can be synthesised from sucrose with the help of enzymes obtained from GMOs.

Merits: Genetic engineering allows of plants or animals to be modified so their maturity can occur at a **quicker** pace, even if the normal growth conditions are not favourable.

- Genetic modification can help to create resistance to common forms of organism death, thereby **extending life**. Eg: pest resistance in plants without use of any additives.
- **Specific traits can be developed** through genetic engineering that can make them more attractive to use or consumption.
- **New products** can be created by adding or combining different profiles together.
- It can also change the traits of plants or animals so that they produce **greater yields**. This could potentially reduce **global food insecurity.**
- Contributes significantly to biotechnology research by enabling researchers to isolate the exact gene causing diseases, giving them insights to the possible cures.

Demerits: The nutritional value of foods can be less; When animals grow, and mature quickly, the nutritional value of that product can be reduced. This can be seen in poultry products today.

- Pathogens evolve a resistance to the resistance that is created by the genetic engineering efforts, causing them to become stronger than they normally would be, potentially creating future health concerns that are unforeseen.
- **There can be negative side effects that are unexpected. Eg:** Animals may be modified to produce more milk, but have a shortened lifespan at the same time so farmers suffer a greater loss in livestock.
- Many companies **copyright** their genetic engineering processes or products to maintain their profitability. This can have several **costly consequences.**
- Genetic engineering can change specific traits, which could create human outcomes that are **ethically questionable or easily abused.**
- **The amount of diversity developed can be less favourable;** the engineered organisms often dominate, resulting in only a modified species over several generations, reducing the diversity that is available.
- Scientists believe that it has associated consequences and **possible irreversible effects** on humans and the environment.

Conclusion: Genetic engineering is a scientific breakthrough that has led to developments in biotechnology. Ethical issues arise as they try to determine if GM crops are good or bad for humans. Genetic engineering can also be dangerous and has to used responsibly.

URBAN SPRAWL

Introduction

Urban sprawl refers to the migration of a population from populated towns and cities to low density residential development over more and more rural land. The end result is the spreading of a city and its suburbs over more and more rural land.

Urban sprawl is defined as low density residential and commercial development on undeveloped land. Most of the time, people will move from these areas to try to find better areas to live. This has been the way of the world since the beginning.

Urban Sprawl means increase in spatial scale or increase in the peripheral area of cities.

Batty et al. defined sprawl as "uncoordinated growth: the expansion of community without concern for its consequences, in short, unplanned, incremental urban growth which is often regarded unsustainable."

An excellent example of urban sprawl within our country is that of the city of Bangalore. After the establishment of IT industry in Bangalore, the population exploded from 24,76,355 in 1980 to 42,92,223 in 2001 with influx of 18 lakh immigrants within two decades. The growing population has increased pressure on several resources including civic amenities, residential availability, cost of living, local infrastructure, transport, traffic and administration. Bangalore has lost many if its water bodies (lakes) and consequently the fragile ecosystem have been disturbed due to the ever-increasing need for space, to cater to residences and business establishments.

Causes of Urban Sprawl: Urban sprawl can be caused by a variety of different things. These causes will mainly include:

- **Lower Land Rates:** Lower cost land and houses in the outer suburbs of the cities, because the centres of urban development have really made people want to stop settling in these areas and want to venture further out.

- **Improved Infrastructure:** There is increased spending on certain types of infrastructures, including roads and electricity. This is something that hasn't always been available, and there are still some areas that don't have these luxuries. That doesn't mean that they aren't working on it.

- **Rise in Standard of Living:** There are also increases in standards of living and average family incomes, which means that people have the ability to pay more to travel and commute longer distances to work and back home.

- **Lack of Urban Planning:** People love to find areas that are less trafficked and more calm, which leads them to sprawl out to other sections of the town. Unprecedented development, cutting of trees, loss of green cover, long traffic jams, poor infrastructure force people to move out to new areas.

- **Lower House Tax Rates:** Cities will usually have high property taxes, and you can usually avoid these taxes by living in the outer suburbs because the taxes are usually lower than they would be in other situations.

- **Rise in Population Growth:** Another factor that contributes towards urban sprawl is rise in population growth. As number of people in a city grows beyond capacity, the local communities continue to spread farther and farther from city centres.

- **Consumer Preferences:** People in high income groups have stronger preferences towards larger homes, more bedrooms, bigger balconies and bigger lawns. This also causes urban sprawl as this option is not available in crowded cities. People generally look out for low-density residential areas where they can get home according to their preference.

EFFECTS of Urban Sprawl

- **Increase in Public Expenditure:** They can actually play a part in the increase of public costs, because these changes in infrastructures and building must actually be paid for by someone- and it is usually the tax payers' money that pays for it.

- **Increased Traffic:** People will begin to use their cars more often; there is more traffic on the roads, and there is also more air pollution and more accidents.

- **Health Issues:** When people use their vehicles, even to go to a very short distance, people are going to be more overweight and are also going to have to deal with ailments such as high blood pressure and other diseases that come about with obesity.

- **Environmental Issues:** When you think about going out to develop these lands you will have to worry about the wildlife that lives there. They will be displaced and it can cause a ripple in the environment.

- **Impact on Social Lives:** When people move further out, they also have an impact on their social lives. They don't have neighbours that live as close, which means that they won't really stay as social as they should. (though not always)

Benefits:

Efficiency: Cities are extremely efficient. Less effort is needed for basic amenities like water and electricity. Research and recycling programs are possible. Many people can be accommodated within small area (flat system).

Convenience: Access to education, health, social services and cultural activities is more readily available in cities. Life is much more advanced, sophisticated and comfortable. Advanced communication and transport networks are available.

Educational facilities: A wide variety of choices in education courses, schools, universities are available, offering a diverse range of choices for students.

Social integration: People of many different castes and religions work together in cities. This promotes harmony, better understanding and helps to break down social and barriers.

Improvements in economy: High-tech industries earn valuable foreign exchange and lot of money for a country in their stock markets.

CONCLUSION: Urban sprawl is something that will continue to occur as long as we live here on earth. It isn't something that is going to change, but over time the more rural areas are going to become more populated because of development and change. This can be considered a good as well as a bad thing. It is important to take note that it will actually play a part in having to cut down more trees and tear up the environment which is not a good aspect.

Unit :3 Development of Environmental Education

(a) HISTORICAL DEVLOPMENTS: STOCKHOLM CONFERENCE [1972]

United Nations Conference on the Human Environment, byname **Stockholm Conference**, the first United Nations (UN) conference that focused on international environmental issues. The conference, held in Stockholm, Sweden, from June 5 to 16, 1972, reflected a growing interest in conservation issues worldwide and laid the foundation for global environmental governance. The final declaration of the Stockholm Conference was an environmental manifesto that was a forceful statement of the finite nature of Earth's resources and the necessity for humanity to safeguard them. The Stockholm Conference also led to the creation of the United Nations Environment Programme (UNEP) in December 1972 to coordinate global efforts to promote sustainability and safeguard the natural environment.

The roots of the Stockholm Conference lie in a 1968 proposal from Sweden that the UN hold an international conference to examine environmental problems and identify those that required international cooperation to solve. The 1972 conference was attended by delegations from 114 governments. (It was boycotted by Soviet-bloc countries because of the exclusion of the German Democratic Republic [East Germany], which did not hold a UN seat at the time.) Documents created during the conference influenced international environmental law; one notable example was the final declaration, which elucidated 26 principles concerning the environment. The conference also produced the "Framework for Environmental Action," an action plan containing 109 specific recommendations related to human settlements, natural-resource management, pollution, educational and social aspects of the environment, development, and international organizations.

The final declaration was a statement of human rights as well as an acknowledgment of the need for environmental protection. The first principle began "Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being." The need to preserve the environment was not placed in opposition to economic development. In fact, their interdependence was explicitly stated in principles 8 and 9.

Several other topics were also treated by the final declaration. These topics included:

- the necessity of conservation, including the preservation of wildlife habitat (principle 4),
- the avoidance of polluting the seas (principle 7),
- the wide use of nonrenewable resources (principle 5),
- the importance of developing coordinated planning (principles 13–17),
- the importance of environmental education (principle 19),
- the facilitation of scientific research and the free flow of information (principle 20),
- the development of international law regarding environmental pollution and damage (principle 22),
- and the elimination and destruction of nuclear weapons (principle 26).

INTERGOVERNMENTAL CONFERENCE [1977]

The world's first intergovernmental conference on environmental education was organized by the United Nations Education, Scientific, and Cultural Organization (UNESCO) in cooperation with the U.N. Environment Programme (UNEP) and was convened in Tbilisi, Georgia (USSR) from October 14-26, 1977.

Delegates from 66 member states and observers from two nonmember states participated. Representatives and observers from eight U.N. agencies and programs also participated. Three other intergovernmental organizations and 20 international nongovernmental organizations also were represented. In all, 265 delegates and 65 representatives and observers took part in the conference.

The declaration noted the unanimous accord in the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities.

Kyoto protocol [2005]

The **Kyoto Protocol** is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that (part one) global warming is occurring and (part two) it is extremely likely that human-made CO_2 emissions have predominantly caused it. The Kyoto Protocol was adopted in Kyoto, Japan on 11 December 1997 and entered into force on 16 February 2005. There are currently 192 parties (Canada withdrew from the protocol, effective December 2012) to the Protocol.

The Kyoto Protocol implemented the objective of the UNFCCC to reduce the onset of global warming by reducing greenhouse gas concentrations in the atmosphere to "a level that would prevent dangerous anthropogenic interference with the climate system" (Article 2). The Kyoto Protocol applies to the six greenhouse gases listed in Annex A: Carbon dioxide (CO2), Methane (CH4), Nitrous oxide (N2O), Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6).

The Protocol is based on the principle of common but differentiated responsibilities: it acknowledges that individual countries have different capabilities in combating climate change, owing to economic development, and ergo puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere. The main goal of the Kyoto Protocol is to control emissions of the main.

The Protocol defines three "flexibility mechanisms" that can be used by Annex I Parties in meeting their emission limitation commitments.[39]:402 The flexibility mechanisms are International Emissions Trading (IET), the Clean Development Mechanism (CDM), and Joint Implementation (JI). IET allows Annex I Parties to "trade" their emissions (Assigned Amount Units, AAUs, or "allowances" for short).

Tbilisi + 30 (2007)

The fourth International Conference on EE, held in Ahmadabad, India in 2007 within he framework of the UN DESD, marks 30 years after Tbilisi. This documents reflects views a perspectives of over 1,500 people from 97 countries attending the Ahmadabad Conference. It concentrates on common themes raised in the conference, and is complimented by a conference Declaration and recommendations on more than 30 topics discussed by working groups at the conference.

The conference further recommends changes in several areas of thinking and practice.

- Change thinking about education and learning:
- Change patterns of leadership and partnership formation:
- Change how we understand environmental issues:
- Change how we conceptualize and engage with the environment development relationship:
- Change how knowledge is viewed, and our communication practices:
- Change sites of learning and participation patterns and practices:

These recommendations were adopted by the Delegates of the 4th International Conference on Environmental Education on 28th of November 2007 at the Center for Environment Education, Ahmadabad, India.

b)Environmental Education: Meaning , objectives, Principles and Significance

Environmental Education :-

- Meaning
- Objectives
- Principles

- Significance
- **Meaning :-** Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions.

The **Objectives** of environmental education are:

- **Awareness and sensitivity** to the environment and environmental challenges
- **Knowledge and understanding** of the environment and environmental challenges
- **Attitudes** of concern for the environment and motivation to improve or maintain environmental quality.
- **Skills** to identify and help resolve environmental challenges
- **Participation** in activities that lead to the resolution of environmental challenges

Environmental education does not advocate a particular viewpoint or course of action. Rather, environmental education teaches individuals how to weigh various sides of an issue through critical thinking and it enhances their own problem-solving and decision-making skills.

Principles of Environmental Education:

- To consider environment in its totality (natural, artificial, technological, ecological, moral, aesthetic).
- To consider a continuous life process.
- To be interdisciplinary in approach.
- To focus on current, potential environmental situations.
- To emphasize active participation in prevention and control of pollution.
- To examine root cause of environmental degradation.
- To provide an opportunity for making decisions and accepting their consequences.

Significance:- Environmental education (EE) is often lauded by educators as an ideal way to integrate academic disciplines, stimulate the academic and social growth of young people, and promote conservation of the natural environment. Just a few of EE's many benefits are listed below.

- Studying EE Creates Enthusiastic Students and Innovative Teacher-Leaders.
- EE Helps Build Critical Thinking and Relationship Skills.
- EE Instructional Strategies Help Foster Leadership Qualities.
- EE Makes Other School Subjects Rich and Relevant.
- EE Teaches Students to be Real-World Problem-Solvers.
- EE Helps Students Become Self-Directed Learners.
- EE Gets Apathetic Students Excited About Learning.
- EE Schools Demonstrate Better Academic Performance across the Curriculum.
- EE Is a Perfect Match for Community Service Learning Requirements.
- EE Offers All Students Equal Chances for Academic Success.
- Access to Nature and Outdoor Play Offer a Host of Health Benefits .

C)Approaches of Teaching Environmental Education (Multidisciplinary and Interdisciplinary)

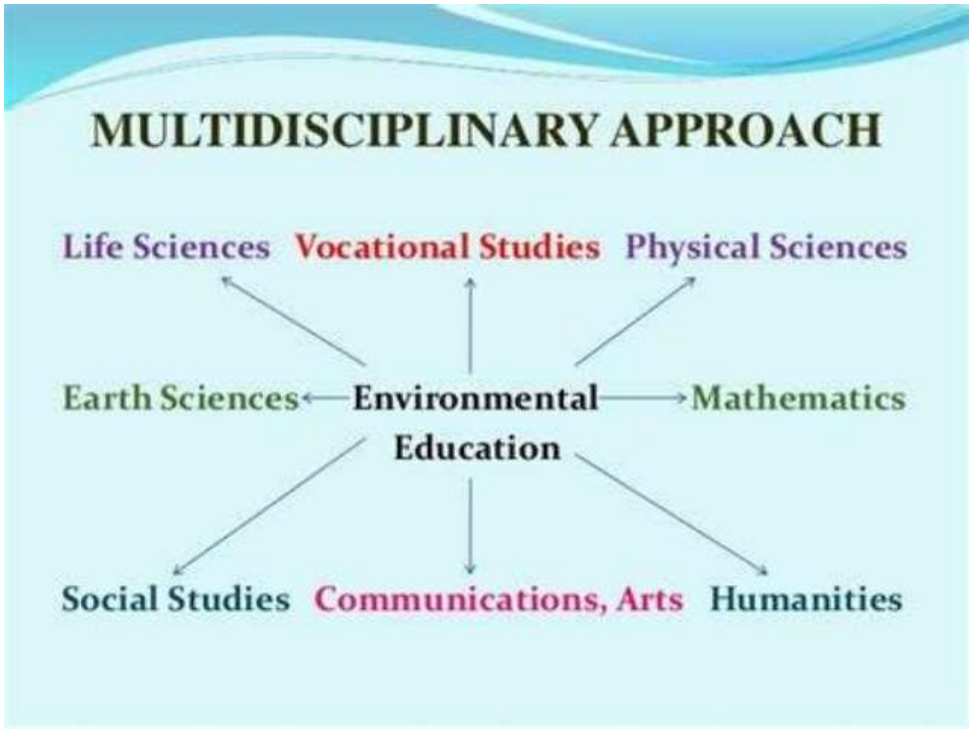
The total environment consists of and is impacted by various interconnected framework s, namely, physical, biological, social, legal, political, economic, and cultural. The interrelationship between such elements is a major consideration needed to develop integrated environmental solutions that are acceptable from the standpoint of economics, political reality, and public attitudes it is well recognized that protecting and preserving environmental qualities require input from multidisciplinary experts, and that. A quality interdisciplinary environmental education offers vast opportunities and cultivates the ability of future environmental scientists and engineers to recognize the components contributing to environmental problems.

Meaning of inter disciplinary and multidisciplinary approach

Interdisciplinary approach: it is an approach where in concept from various disciplines or subjects will be utilised to highlight the environmental perspective or analyse an environmental problem or issue.

Multidisciplinary approach:

In this approach environment topics are dispersed or infused in to various single disciplinary courses. In other words the environmental perspective is integrated in to other discipline.



Interdisciplinary approach

It is an instrumental necessity. It facilities construction of knowledge both directly and indirectly as an aid to preliminary formation of basic personality

Interdisciplinary environmental education is concerned to give more global less schematic view centred on environmental problems more important it stresses analysis as a vehicle for alternative solution.

The first requirement is to introduce in to each discipline the environmental dimension as needed to cover the general objective not programed by the traditional discipline ecology in the national science, economics and sociology and the social science architecture urbanism as so forth

Education centred on concrete environmental problems implies conversely that various aspects of knowledge of coaleac to provide explanation of complex reality the structures should established a special relationship encompassing sensitization to the environment the acquisition of data, the ability to solve problems, clarification of values and direct or indirect participation of within the community as protecting and improving environment.

Interdisciplinary also offers an approach to complex activities that given conception cannot emerge from "rationally "constructed disciplinary curriculum. The centre of interest pinpointed by environmental studies pollution environmental nuisance etc. are either inaccessible through strict disciplinary exposition or require complex of disciplinary knowledge that students do not possess.

Disciplinary programs are in fact very far from these interest of most learners who are caught up in cultural environment very different from the school and who are very much influenced by the media. Here two an interdisciplinary approach can build the foundation of useful knowledge learner's preoccupations and motivation.

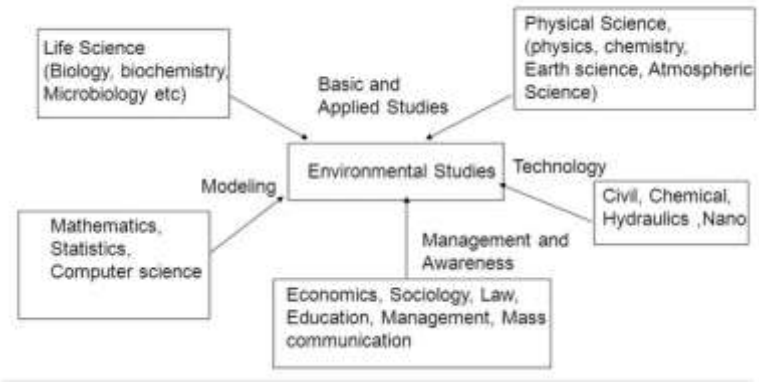
Interdisciplinary environmental education is not a discipline a new subject but pedagogical modality aiming at efficient teaching. It is either an objective now a goal in itself but a way to enable a learner to situate himself better in his school program and to asserts his needs in a more global or harmonious fashion then is allowed by the sectorial approach of disciplines while more easily accruing the attitudes methods and concepts necessary to control his environment.

Incorporating such an approach is not a simple process. The possible method for achieving it are neither mutual exclusive nor necessarily successive. Possible solutions can be combined. They should be however be adaptive to each country levels of formal education.

Multidisciplinary approach
Environmental Studies is a **multidisciplinary** science because it comprises of various

branches of studies such as chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering, etc. It is the science of physical phenomena in the environment. It educates individuals from various walks of life about the delicate balance of nature and the recklessness with which we are damaging this environment thereby endangering our very existence. This has been illustrated in real life in the past and continues through the present age. Environment studies is a study of the sources, reactions, transport, effect and fate of human activities on biological species in air, water and soil. An understanding of the working of the environment require knowledge from wide ranging fields. The multidisciplinary nature of environment studies with respect to air pollution is shown in the table below:

Environmental issue / topic	**Major Subject**
Nature and reaction of air pollutants	Chemistry and chemical engineering
Effects of air pollution on humans, animals and plants	Zoology, Botany, and various branches of life science, physics and chemistry
Effects of air pollution on climate	Mathematical modelling
Air pollution control devices	Physics, Chemistry and various branches of engineering
Economic effects of Air pollution	Economics, Demography
Conservation of resources and pollution control	Various branches of physical and political science



. Environmental studies is therefore multidisciplinary and aims at unravelling the ways in which human beings and nature correlate, sustaining life and man's unquenchable thirst for development with limited and infinite resources

Unit 4

4a) Environmental Impact Assessment: Meaning, Steps & Significance

Definitions of EIA:

- Environmental Impact Assessment is defined as an activity designed to identify the impact on the bio geophysical environment, on man and well-being of legislative proposals, projects, policies, operational procedures and to interpret and communicate information.
- EIA is a systematic process of identifying future consequences of a current or proposed action.

Meaning

- ✓ Environmental impact assessment An environmental impact assessment is an assessment of the possible positive or negative impacts that a proposed project may have on the environment .social and economic aspects .The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether or not to proceed with a project The International Association for Impact Assessment defines an environmental impact assessment as.

Steps

1. Submission of preliminary information (Identifying and Defining the Project):

The project proponent should submit information regarding the nature, location and impacts of a EIA. It is very important to identify the team that will carry out the EIA procedure along with a coordinator and the decision maker who will read the final report.

2. Environmental Screening:

. Once a developer has identified a need and two important questions must be asked: 'What will be the effects of this development on the environment? Are those effects significant? answering this question is a process known as screening

3. Environmental Scoping:

Scoping is a stage, usually involving the public and other interested parties, that identifies the key EIA. Scoping actually controls the cost and time of the assessment e.g Checklist technique, Matrix technique, Networks technique, Overlay technique.

4. Consideration of alternatives:

This seeks to ensure that the proponent has considered other feasible approaches, including alternative project locations, scales, processes, layouts, operating condition and the no-action option.

5. Description of the environmental baseline:

Following on from scoping, it is essential to collect all relevant information on the current status of the environment .technical expertise, long term database for environmental measures

6. Impact assessment:

The most difficult and controversial part of the EIA. It is difficult because not every impact, especially natural and social impacts, can be quantified.

7. Mitigation measures:

These measures are taken to reduce the magnitude or intensity of the impacts affecting the EIA team has to decide between two alternatives, either having a high cost and low pollution or having a low cost but a high pollution.

8. Public Participation:

Public participation may consist of informational meetings, public hearings, and opportunities to provide written comments about a proposed project.

9. Producing the environmental impact statement:

A formal document, known as an environmental impact statement (EIS), information gathered relating to screening, scoping, baseline study, impact prediction and assessment, mitigation, and monitoring measures..

10. EIS review:

The competent authorities are often in a position of having very little time to make a decision and have a detailed and lengthy EIS to read through which may contain errors, omissions, and developer bias.

11. Decision:

i. accepting one of the project alternatives

ii. returning the EIA with a request for further study in certain specific areas

iii. totally rejecting the proposed project along with alternative versions.

12. Auditing:

This follows monitoring and involves comparing actual outcomes with predicted outcomes, and can be used to assess the quality of predictions and the effectiveness of mitigation.

Significance

- An assessment of potential impacts on the environment prior to the approval of investment proposals provides a means of harmonizing and integrating the three pillars of sustainable development.
- Therefore, the importance of EIA for sustainable development is *HUGE*.
- *EIA study identifies both the potential positive and negative impacts of the project in advance.*

For negative impacts upon the natural and the socio-economic environment, possible paths/mitigation measures were identified in advance.

This enables *avoidance* and/or *minimization* of impacts and *make the project environmentally-friendly* and acceptable to the nearby community.

- Therefore, EIA is an *instrument/tool* that facilitates ‘identification’ of potential impacts and development of mitigation measures to reduce adverse significant

impacts and foster sustainable development: *Development that does not cost the Earth*!

4b) Environmental Management and Protection Need for environmental management, Function and Characteristics of environmental management.

Environmental management is the process to improve the relationship between the human beings and environment which may be achieved through check on destructive activities of man, conservation, protection, regulation and regeneration of nature. It involves the mobilization of resources and the use of government to administer the use of both natural and economic goods and services.

The process, environmental management is related to the rational adjustment of man with nature involving judicious exploitation and utilization of natural resources without disturbing the ecosystem balance and ecosystem equilibrium.

Environmental management must take into consideration the ecological principles and socioeconomic needs of the society i.e., it involves socio economic developments on one hand and maintenance of environmental quality on other hand.

Need for Environmental Management

1. For use of resources

Resources are limited, if we don't use them properly, they will get exhausted very soon. For appropriate, reasonable and optimum use of resources, environmental management is necessary. It is our basic responsibility to create an accurate coordination and equilibrium between our needs and procedure of environment.

2. To overcome environment and ecology crisis

The present development has reached a point where environment and ecology are in crucial crisis and will create a disastrous effect on the environment.

3. For sustainable development

Environmental management is required for development without destruction or overuse of natural resources and to reduce pollution and degradation of nature. Considering the welfare of future generations, proper decisions regarding use of environment are necessary.

4. For economic need and values

Environmental Management is required to give new directions to our economic needs and values, at the same time to maintain clean environment.

5. To reduce disasters

Environmental Management reduces the risk of disasters like flooding, forest fire, earthquakes, desertification, transport accidents, global warming, etc. We need to explore the link between environmental system and disasters and the synergies between man-made and natural disasters.

6. To decide the limiting line between environment and development

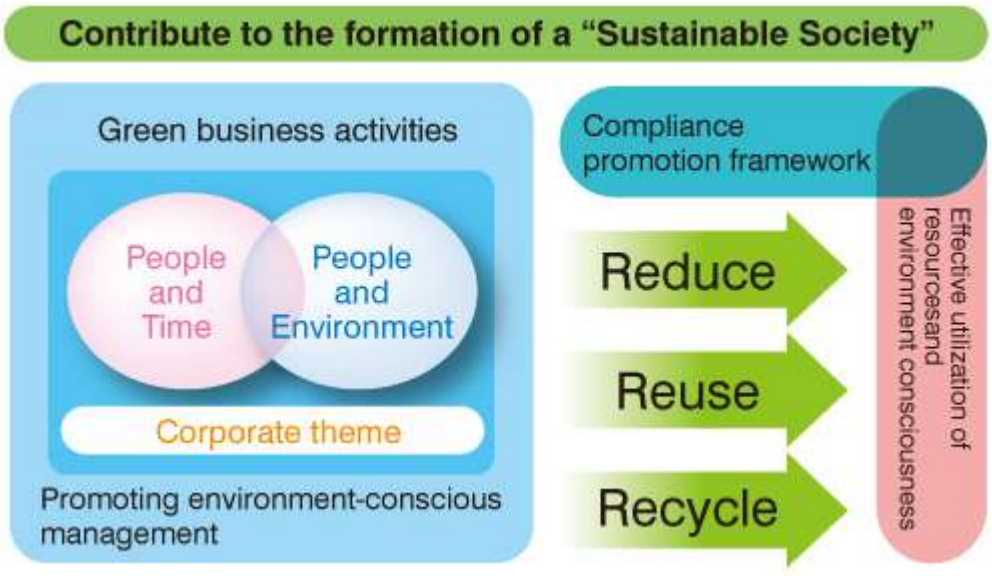
Environmental Management is essential to draw a line of limit for development and environment. For E.g. If our developmental needs leads to global warming or depletion of the ozone layer, then we must not use any hazardous materials, and modify our way of development.

7. Every Organization Needs an Environmental Management System. It helps reduce an organization's impact on the environment while improving operating efficiency.

Environmental management characteristics are follows: -

1. Environmental management supports sustainable development.

   Sustainability is the process of maintaining change in a balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.



2. Environmental management demands the multi-disciplinary approach. It deals with a world affected by humans.
3. Environmental management integrates different development viewpoints.
4. Environmental management seeks to integrate natural and social science.
5. Environmental management can extend from short-term to long-term and from local to global level.
6. It shows opportunities and addresses threats and problems.

Functions of Environmental Management

1. Environmental management educates the people for preserving the quality of environment.
2. It develops an awareness and sensitivity to the total environment and its related problems.
3. Motivates people for active participation in environmental protection and improvement.
4. Develops skills for active identification and development of solutions to environmental problems.
5. Imbibes and inculcates the necessity for conservation of natural resources.
6. Evaluation of environmental programmes in terms of social, economic, ecological and aesthetic factors.
7. To develop research institutions and monitoring systems.
8. To warn threats and identify opportunities.
9. To suggest measures for resource conservation.
10. To suggest long-term and short-term policies for sustainable development.
11. To identify new technology for sustainable development.

4c) Environmental Audit: Definition, Features and Types

<u>Environmental Audit</u>

<u>Introduction</u>

Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards. Environmental auditing is used to

- investigate
- understand
- identify

These are used to help improve existing human activities, with the aim of reducing the adverse effects of these activities on the environment. An environmental auditor will study an organisation's environmental effects in a systematic and documented manner and will produce an environmental audit report. There are many reasons for undertaking an environmental audit, which include issues such as environmental legislation and pressure from customers.

Definitions

The term 'audit' has its origins in the financial sector. **Auditing**, in general, is a methodical examination - involving analyses, tests, and confirmations - of procedures and practices whose goal is to verify whether they comply with legal requirements, internal policies and accepted practices.

The International Chamber of Commerce (ICC) produced a definition in 1989 which is along the same lines

A management tool comprising systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of helping to safeguard the environment by facilitating management control of practices and assessing compliance with company policies, which would include regulatory requirements and standards applicable.

The key concepts, which occur in all the definitions, are as follows.

- **Verification**: audits evaluate compliance to regulations or other set criteria.
- **Systematic**: audits are carried out in a planned and methodical manner.
- **Periodic**: audits are conducted to an established schedule.
- **Objective**: information gained from the audit is reported free of opinions.
- **Documented**: notes are taken during the audit and the findings recorded.
- **Management tool**: audits can be integrated into the management system (such as a quality management system or environmental management system).

Features of Environmental Auditing

- **Systematic**-Environmental audit is a systematic process that must be carefully planned, structured and organized. As it is part of a long-term process of evaluation and checking, it need to be a repeatable process so that over time, it can be easily used by different teams of people in such a way that te results are comparable and can reflect change in both quantitative and qualitative terms.

- **Objective Evaluation** – Though environmental auditing is conducted using pre-decided policies,procedures and a proper documented system, there is always an element of subjectivity in an audit, particularly if it is conducted internally. In addition to internal environmental that have audits, having independent audit team that have specialized skills and who come back periodically to repeat audits tends to increase objectivity in the system. Hence for the sake of objectivity, external environmental audits are preferable. This is also required under many certification guidelines (e.g.ISO14001).
- **Periodic** – Environmental audit is generally conducted at pre-defined intervals. It is a long – term process.
- **Documented** – Like any other audit, the base of any environmental auditing is that its findings are supported by documents and verifiable information.Theaudit process is designed in such a way that it seeks to verify on a sample basis past actions, activities, events and procedures with available evidences to ensure that they were carried out according to system's requirements and in a correct manner.

Types of Environmental Auditing

An environmental audit is essentially a process, and the way in which this process is utilised will depend on what the organisation wishes to achieve from the audit - this leads to the use of different 'types' of audit.

One of the problems when discussing the various uses of environmental auditing is that different people use different names to describe the different 'types'. The list below (after Humphrey and Hadley 2000) will act as a starting point for the purpose of this unit.

Corporate audit

- **Compliance**, eg
  - Regulatory
  - EMS
  - Internal standards
- **Liability**, eg
  - Pre-acquisition
  - Divestment
  - Insurance
- **Single Issue**, eg
  - Waste minimisation
  - Transport etc

Product audit

- **Lifecycle assessment** etc

There are lots of different ways of defining these different types of audits and often different terms are used for the same sort of audit. Other terms you may come across include: health and safety audit, minimisation audit (a form of issues audit above, site audit, due diligence audit (a form of liability audit), activity or operational audit (eg across company departments or units, such as waste and energy management).

A compliance (or legislative) audit aims to determine the degree of company compliance with current or prospective legislation or standards, including, for example, discharge consents.

A liability (or transactional) audit is usually conducted prior to buying or selling a facility/land in order to identify potential liabilities, both financial and legal.

A minimisation audit generally concentrates on a single issue, for example, waste or water, and seeks to identify ways to reduce the amount of waste produced, or water consumed.

An issue audit which concentrates on a topic that has been identified as requiring further investigation, for example, packaging.

Policycompliance audits are primarily internal management tools, and determine the depth of compliance with company policy (internal standards in the list above). They should also act as a means of establishing future strategy. These audits have a similarity with legislative audits, in that, in both cases, compliance is being determined: in one case it is compliance with legal requirements, in the other, compliance with company environmental policies.

Environmental management systems audits are internal audits which are part of any management systems approach. Environmental management systems audits provide the means by which the effective operation of the system can be checked, and remedial action taken if necessary.

Although the majority of the audits described above would be applicable to a particular industry or site, it is also possible to carry out audits for an entire industry and for public authorities, for example, a local authority.

Whatever the objectives, carrying out an environmental audit essentially involves **three main questions** for an organisation.

- **What are our current effects on the environment?**
- **Can we reduce our negative effects on the environment?**
- **How can we make further improvements?**

This applies equally to an audit of an entire organisation, a single site, or even an audit of a particular issue, for example, energy.

Unit 5

5a) Sustainable Development: Meaning, Need, Guiding Principles

Sustainability can be defined as the practice of maintaining processes of productivity, indefinitely natural or human made, by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems. Sustainable development ties together concern for the carrying capacity of natural systems with the social, political, and economic challenges faced by humanity. There is an additional focus on the present generations' responsibility to regenerate, maintain and improve planetary resources for use by future generations.

Sustainable development has its roots in ideas about sustainable forest management which were developed in Europe during the 17th and 18th centuries. In response to a growing awareness of the depletion of timber resources in England, John Evelyn argued that "sowing and planting of trees had to be regarded as a national duty of every landowner, in order to stop the destructive over-exploitation of natural resources" in his 1662 essay Sylva. In 1980 the International Union for the Conservation of Nature published a world conservation strategy that included one of the first references to sustainable development as a global priority[8] and introduced the term "sustainable development". Two years later, the United Nations World Charter for Nature raised five principles of conservation by which human conduct affecting nature is to be guided and judged. In 1987 the United Nations World Commission on Environment and Development released the report Our Common Future, commonly called the Brundtland Report. The report included what is now one of the most widely recognised definitions of sustainable development.

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

· The concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given; and

· The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.”

— World Commission on Environment and Development, Our Common Future (1987)

Need

Since its inception, the term ‘Sustainable development’ has developed beyond the initial intergenerational framework to focus more on the goal of "socially inclusive and environmentally sustainable economic growth".

The need of ‘Sustainable development’ is to create a just, sustainable, and peaceful global society in the 21st century. The action plan Agenda 21 for sustainable development identified information, integration, and participation as key building blocks to help countries achieve development that recognises these interdependent pillars. Furthermore, Agenda 21 emphasises that broad public participation in decision making is a fundamental prerequisite

for achieving sustainable development. Under the principles of the United Nations Charter the Millennium Declaration identified principles and treaties on sustainable development, including economic development, social development and environmental protection. It stresses the need to change from old sector-centred ways of doing business to new approaches that involve cross-sector co-ordination and the integration of environmental and social concerns into all development processes.

Sustainable development is needed to manage natural, produced, and social capital for the welfare of us and our future generations. The term is associated with land development and broader issues of human development such as education, public health, and standard of living.

Guiding Principles

Sustainable Developmental Goals

Sustainable Development Goals (SDGs) are a collection of 17 global goals set by the United Nations General Assembly in 2015. The SDGs are part of Resolution 70/1 of the United Nations General Assembly: "Transforming our World: the 2030 Agenda for Sustainable Development." The goals are broad and interdependent, yet each has a separate list of targets to achieve. Achieving all 169 targets would signal accomplishing all 17 goals. The SDGs cover social and economic development issues including poverty, hunger, health, education, global warming, gender equality, water, sanitation, energy, urbanization, environment and social justice.

Goal 1: No poverty

"End poverty in all its forms everywhere."

Goal 2: Zero hunger

"End hunger,achieve food security and improved nutrition, and promote sustainable agriculture".

Goal 3: Good health and well-being for people.

"Ensure healthy lives and promote well-being for all at all ages."

Goal 4: Quality education.

"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."

Goal 5: Gender equality.

"Achieve gender equality and empower all women and girls."

Goal 6: Clean water and sanitation.

"Ensure availability and sustainable management of water and sanitation for all."

Goal 7: Affordable and clean energy.

"Ensure access to affordable, reliable, sustainable and modern energy for all."

Goal 8: Decent work and economic growth.

"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all."

Goal 9: Industry, Innovation, and Infrastructure.

"Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation."

Goal 10: Reducing inequalities.

"Reduce income inequality within and among countries."

Goal 11: Sustainable cities and communities.

"Make cities and human settlements inclusive, safe, resilient, and sustainable."

Goal 12: Responsible consumption and production.

"Ensure sustainable consumption and production patterns."

Goal 13: Climate action.

"Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy."

Goal 14: Life below water.

"Conserve and sustainably use the oceans, seas and marine resources for sustainable development."

Goal 15: Life on land.

"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."

Goal 16: Peace, justice and strong institutions.

"Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels."

Goal 17: Partnerships for the goals.

"Strengthen the means of implementation and revitalize the global partnership for sustainable development."

5b) Sustainable Environmental Practices

i) Rainwater Harvesting: Meaning, Process and Significance.

Introduction: Rainfall is a good source of water for both domestic and commercial use. Falling rain is always a welcome sight especially after weather characterized by extremely high temperatures.

What is the Meaning of Rainwater Harvesting?

Rainwater harvesting is the process of collecting rainwater and putting it to good use. There are different ways in which this task can be accomplished.

Rainwater harvesting refers to the trapping and storing of rainwater so that it can be used at a later time when the need arises. As the rain falls, water is directed to a suitable collection point.

It can also mean collecting rainwater before it infiltrates into the ground and becomes underground water. Harvesting mainly entails gathering something from its natural source.

Rainwater harvesting, from the common definition of harvesting, is a process that involves collecting rainwater and increasing its value by eliminating impurities or directing it to places where its use is highly required.

It's a practice that has been around for a long time. The only difference is that now better methods have been developed to make the process a great success. New technologies have come into play and are now making the process easier and more efficient.

Rainwater harvesting process:

i. When rainwater falls on a house, it is collected and not allowed to flow away. Rainwater is gathered from the catchment, which is the area that receives rainwater. It can be the roof of the house or the backyard as well.

ii. Mesh filters are placed on terraces to stop external matter like leaves and similar objects from entering the tanks with rainwater.

iii. There is a filter unit with these tanks that helps filter the rainwater which is accompanied with dust and grime.

iv. The second stage of filtering rainwater is with charcoal or sand filters to remove debris from the water before disposing it to the storage tank or the recharge area.

v. This rainwater is accumulated in underground tanks. The water is stored in a masonry tank or a plastic tank. These tanks have motors and conduits, or pipes, so that water can be directed properly. The tanks are also capable of managing an overflow of water that can happen in the case of a sudden rain.

vi. Groundwater recharge is required in places that do not have good quality of rainfall or where the chances of dirty water are more. These recharge structures can be borewells or trenches.Water is an important natural resource and is the very basis of our life. We use water for drinking, irrigation, industry, transport and for the production of hydro-electricity. Water is a cyclic resource which can be used again and again after cleaning. The best way to conserve water is its judicious use.

Significance:

1.Rainwater harvesting or the collection of rainwater in a proper way, can be a permanent solution to the problem of water crisis in different parts of the world. This simple method can put forward a solution which will be workable in areas where there is sufficient rain but the groundwater supply is not sufficient on the one hand and on the other surface water resource is insufficient. This is particularly applicable in hilly areas where it can be utilized for human consumption, by animals and also for farming. In remote areas, where surface pollution is comparatively low, rainwater harvesting is ideal.

2.. If rain water, which comes for free, can be collected and stored, instead of letting it run off, it **could be an alternative to back up the main water supply especially during dry spells**. Systematic rainwater harvesting can help in irrigation with minimum use of technology and is therefore cost effective. This simple method can help farmers to prevent their crops from drying due to lack of water. It also creates a sense of social responsibility and awareness about the environment.

3. The **importance of rainwater harvesting lies in the fact that it can be stored for future use**. Just as it can be used directly so also the stored water can be utilized to revitalize the ground level water and improve its quality. This also helps to raise the level of ground water which then can be easily accessible. When fed into the ground level wells and tube well are prevented from drying up. This increases soil fertility. Harvesting rainwater checks surface run off of water and reduces soil erosion.

3. In areas having sparse and irregular rainfall, scarcity of water is a persistent problem. It cannot be completely resolved but can be mitigated through rain water harvesting. Rainwater harvesting is an **ideal solution to water problems in regions which receive inconsistent rainfall throughout the year**.

Conclusion

Rainfall is a very important weather phenomenon. It is a source of water and is very critical for the growth of crops and farming. Harvesting rainwater is a practice that has been going on

for a while. Many people actually engage in it without even realizing that they are doing so. Because of weather changes, water sources can dry up and in the process impact animal, human, and plant life negatively. Rainwater harvesting is a smart way of preparing for such times because even when the conventional water sources dry up, we can still use the stored water for many purposes. The best part is that this type of water is naturally occurring. Some of the setbacks can be avoided by taking precautionary measures. When we employ innovation and technology, we can come up with better ways of rainwater harvesting and increase the storage capacity.

5b) ii) MANGROVES MANAGEMNET

Definition of Mangroves :

Mangroves are salt tolerant characteristic complex plant communities occurring in sheltered coast line areas in the tropical and sub-tropical inter-tidal regions of the world such as bays, estuaries, lagoons and creeks.

Types of Mangroves

- **Black mangroves**
- **Red mangroves**
- **White mangroves**

Definition of Mangroves Management

Mangrove management is an effective way of maintaining and enhancing the **protection** function of the **mangrove** forest while providing livelihood for local people and contributing to better assessment and governance of natural resources.

Some of the Important Mangrove Species in India

Avecennia alba

Avecennia officianalis

Avecennia marina

Bruguiera cylindrical

Kendella candel

Rhizophora apiculata

Sonneretia species

Process of Mangrove management

1. Mapping and Situational analysis - Understanding the bio physical conditions, resources available and patterns of resource utilization by stakeholders

2. Selection of Project hamlets - to select hamlets based on socio-economic conditions, intensity of use of mangrove resources and willingness to actively participate.

3. Participatory Appraisal of the Area - The next step in the process is to understand the major concerns of the people relating to mangrove conservation and management and also socio-economic development as well as to build rapport with the people.
4. Formation of village level Mangrove Council to identify area of wetlands traditionally used by the community without any conflict and identify activities to restore and conserve and preserve.
5. Preparing an Annual Micro-Plan mobilise funds. Etc, even activities.

6. Implementation of the set plans

7. Monitoring

8. Evaluation through feedback of the management

Mangroves Management Significance /need

1) Mangroves as primary sources of energy for tropical estuaries are protected by Mangroves Management
2) Biomass productivity of mangroves is relatively high and they act as reservoir in assimilation of wastes
3) **Ecological Significance of Mangroves:**
   Mangroves provide important nutrient inputs and act as primary sources of energy for tropical estuaries. Biomass productivity of mangroves is relatively high and they act as reservoir in assimilation of wastes. Mangroves stabilize the shoreline and act as bulwark against the devastating impact of hurricanes and cyclones as well as encroachment by the sea and check soil erosion.
4) **Economic Significance of Mangroves**
   Provide vide variety of goods and services such as Durable timbers Fuel wood of high calorific values Protein rich fodder for cattle Edible fruits and vegetables Traditional medicines
5) Main source of income generation for shoreline communities like fisher folk.
6) Buffer Zone between the land and sea.
7) Breeding and nursery grounds for a variety of marine animals. Harbours a variety of lifeforms like invertebrates, fish, amphibians, reptiles, birds and even mammals like tigers

Purify the water by absorbing impurities and harmful heavy metals and help us to breathe a clean air by absorbing pollutants in the air.

5b) ii) Solid Waste Management: Types, Sources, Effects and Methods of Solid Waste Management

What is Solid waste : Solid waste management is a polite term for garbage management. As long as humans have been living in settled communities, solid waste, or garbage, has been an

issue, and modern societies generate far more solid waste than early humans ever did. Solid waste means any garbage.

Garbage: many broad categories of garbage are:

i. Organic waste: kitchen waste, vegetables, flowers, leaves, fruits.

ii. Toxic waste: old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish.

iii. Recyclable: paper, glass, metals, plastics.

iv. Hospital waste such as cloth with blood

1. Types & Source of Solid Wastes**:**

Municipal solid waste – MSW consists of household waste, construction and demolition debris, sanitation residue.

Hazardous waste – industrial and hospital waste is considered as hazardous waste as they contain toxic substances.

Infectious waste – biomedical easy or hospital waste, generated during diagnosis treatment etc. Include sharps, chemical wastes, discarded medicines and human excreta.

Sources of solid waste : Residential, Industrial, commercial, institutional, construction and demolition, municipal services, process (manufacturing etc ..), Agriculture

Need for SWM

- Ground water pollution and environmental degradation, Serious health problems,
- Clogging of drains, Decomposition of organic material, Air, soil pollution,
- Lack of know-how to deal with disposal of waste.

2. Effects of Solid Waste Pollution:
Municipal solid wastes heap up on the roads due to improper disposal system. People clean their own houses and litter their immediate surroundings which affects the community including themselves.

Industrial solid wastes are sources of toxic metals and hazardous wastes, which may spread on land and can cause changes in physicochemical and biological characteristics thereby affecting productivity of soils.

Toxic substances may leach or percolate to contaminate the ground water. In refuse mixing, the hazardous wastes are mixed with garbage and other combustible wastes. This makes segregation and disposal all the more difficult and risky.

Various types of wastes like cans, pesticides, cleaning solvents, batteries (zinc, lead or mercury), radioactive materials, plastics and e-waste are mixed up with paper, scraps and other non-toxic materials which could be recycled. Burning of some of these materials produces dioxins, furans and polychlorinated biphenyls, which have the potential to cause various types of ailments including cancer.

3. Methods of Solid Wastes Disposal:

i. Sanitary Landfill

ii. Incineration

iii. Composting

iv. Pyrolysis

i. Sanitary Land Filling:
In a sanitary landfill, garbage is spread out in thin layers, compacted and covered with clay or plastic foam. In the modern landfills the bottom is covered with an impermeable liner, usually several layers of clay, thick plastic and sand. The liner protects the ground water from being contaminated due to percolation of leachate.

Leachate from bottom is pumped and sent for treatment. When landfill is full it is covered with clay, sand, gravel and top soil to prevent seepage of water. Several wells are drilled near the landfill site to monitor if any leakage is contaminating ground water. Methane produced by anaerobic decomposition is collected and burnt to produce electricity or heat.

ii. Incineration:
The term incinerates means to burn something until nothing is left but ashes. An incinerator is a unit or facility used to burn trash and other types of waste until it is reduced to ash. An incinerator is constructed of heavy, well-insulated materials, so that it does not give off extreme amounts of external heat.

The high levels of heat are kept inside the furnace or unit so that the waste is burned quickly and efficiently. If the heat were allowed to escape, the waste would not burn as completely or as rapidly.

iii. Composting:
Organic matter constitutes 35%-40% of the municipal solid waste generated in India. This waste can be recycled by the method of composting, one of the oldest forms of disposal. It is the natural process of decomposition of organic waste that yields manure or compost, which is very rich in nutrients.

Composting is a biological process in which micro-organisms, mainly fungi and bacteria, convert degradable organic waste into humus like substance. This finished product, which looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants

iv. Pyrolysis:

Pyrolysis is a form of incineration that chemically decomposes organic materials by heat in the absence of oxygen. Pyrolysis typically occurs under pressure and at operating temperatures above 430 °C (800 °F).

In practice, it is not possible to achieve a completely oxygen-free atmosphere. Because some oxygen is present in any pyrolysis system, a small amount of oxidation occurs. If volatile or semi-volatile materials are present in the waste, thermal desorption will also occur.

5c) Indigenous Technical Knowledge

Indigenous Technical knowledge refers to unique , traditional ,local knowledge existing within and developed around specific conditions of women and men indigenous to a particular geographic area . ITK is the information base for a society , which facilitates communication and decision making . Indigenous information system are dynamic and are constantly influenced by internal creativity and experimentation as well as by contact with external systems .

The term indigenous technical knowledge is often camouflaged with the belief that is associated with forthcoming happenings and innovations made by the farmers to solve specific problems.

As a summary of various definitions , the term indigenous technical knowledge may be denoted mainly as a tacit type of knowledge that has evolved within the local community and has been passed on from one generation to another , encompasses not only local or indigenous knowledge , but also scientific and other knowledge gained from outsiders .

It is specifically concerned with actual application of the thinking of the local people in various operation of agriculture and allied areas. The basic component of any country's knowledge system is its indigenous technical knowledge.

ITK means local knowledge that is unique to a given society and is embedded in their cultural traditions. ITKis an important part of the culture and history of any local community. Through indigenous knowledge, local communities have been able to cope and adapt with the devastating effects of increased climate variability manifested through frequent droughts and floods. They do this by predicting these extreme climatic events using local environmental and astronomical indicators and then use various local coping measures during droughts and floods.

What are the Characteristics of Indigenous Knowledge System?

Indigenous Knowledge is:

Local: It is rooted to a particular set of experiences, and generated by people living in those places. It has been said that transferring that knowledge to other places runs the risk of dislocating it.

2. Orally- transmitted, or transmitted through imitation and demonstration. Writing it down changes some of its fundamental properties.

3. Characteristically shared to a much greater degree than other forms of knowledge, including global science. This is why it is sometimes called "people's science", an appellation which also arises from its generation in contexts of everyday production. However, its distribution is still, segmentary, that is socially clustered (Hobart 1993). It is usually asymmetrically distributed within a population, by gender and age, for example, and preserved through distribution in the memories of different individual. Specialists may exist by virtue of experience, but also by virtue of ritual or political authority.

4. Focused on particular individuals and may achieve a degree of coherence in rituals and other symbolic constructs, its distribution is always fragmentary: it does not exist in tis totality or individual, Indeed, to considerable extent it is devolved not in individuals at all, but in the practices and interactions in which people engage themselves engage.

Indigenous people view the world we live in as an integral whole. Our beliefs, knowledge, arts and other forms of cultural expressions have been handed down through the generations. Integrated in these elements is the knowledge

Why is indigenous Knowledge System Important?

1. Indigenous Knowledge is an integral part of the development process of local communities. According to the 1998/99 World Development Report, knowledge, not capital, is the key to sustainable social and economic development. Building on local knowledge system, is the first step to mobilise such capital.

2. IKS plays a profound role in societies. It helps shape and defines their very existence and provides the foundation for their beliefs and traditional practices.

3. Indigenous knowledge provides the basis for problem-solving strategies for local communities, especially the poor. It represents an important component of global knowledge on development issues. IK is an underutilised resource in the development process. Learning from IK, by investigating first what local communities know and have, can improve understanding of local conditions and to provide a productive context for activities designed to help the communities. Understanding IK can increase responsiveness to clients. Sharing IK within and across communities can help enhance cross – cultural understanding and promote the cultural dimension of development.

a) Biodiversity: Indigenous knowledge can help promote biodiversity conservation by characterising resource uses that are appropriate for the particular local landscape. in fact, incorporating indigenous knowledge into conservation and development activities is believed to be an important mechanism for ensuring the most efficient and productive use of natural resources in the short- term without jeopardising the long-term capacity of nature to continue producing these resources.

What is the relevance of Indigenous Knowledge on the development process?

- Development agents (CBOs, NGOs, governments, donors, local leaders, and private sector initiatives) need to recognise it, value it and appreciate it in their interaction with the local communities. Before incorporating it in their approaches, they need to understand it- and critically validate it against the usefulness for their intended objectives.

- Indigenous knowledge forms part of the global knowledge. In this context, it has a value and relevance in itself. Indigenous knowledge can be preserved, transferred, or adopted elsewhere.

Unit 6

6a) i) TARUN BHARAT SANGH

- **Tarun Bharat Sangh** (TBS) is a non-governmental organization in Rajasthan and directed by Rajendra Singh, known as "waterman of India". He won the Stockholm Water Prize, an award known as "the Nobel Prize for water", in 2015.
- Tarun Bharat Sangh has helped villagers take charge of water management in their semi-arid area through the use of johad, rainwater storage tanks, check dams and other techniques.
- Starting from a single village in 1985, TBS has helped build over 8,600 johads and other water conservation structures to collect rainwater, has brought water back to over 1,000 villages and revived five rivers in Rajasthan, Arvari, Ruparel, Sarsa, Bhagani and Jahajwali.

WORK AT GRASS ROOT LEVEL

1. **Natural Resource Conservation**

- TBS starts its work with mobilising communities around the issue of water, and supporting them in reviving and revitalising the traditional systems of water management through construction of 'Johads' for rainwater harvesting.
- The community contributes their labour; TBS arrange funding and provide support to the villagers in studying the topography and soil type.
- Over 10,000 Rain-Water Harvesting (RWH) structures have been restored in this way. The effects are visible in terms of recharging of wells and aquifers, renewed flow of rivulets, increased bio-mass productivity, and significant increase in agriculture production, reversal of out-migration and reduction in women's drudgery.
- Due to high fodder availability, villagers have also benefited from selling milk products through an informal cooperative arrangement.
- Discussions leading to community actions like regulating the use of pasture land for fuel and grazing, reserving land for grazing, for protecting certain forests, for building check-dams across forest streams and protecting wildlife.

2. Women

- Women in this region have suffered a lot on account of fetching water for the family. They, who are responsible for procuring fodder, fuel wood and fetching water, were most affected by these scarcities. The average time spent on them was 18 hours a day. Therefore, the creation of RWH structures has benefited women immensely.
- Increasing number of girls are now studying in schools who devoted their big spell in fetching water for family, before the existence of Johads.
- Women's groups have been set up who have taken on the responsibility of maintaining the water harvesting structures and they are supported to participate in the entire planning and resource management process in the Gram Sabha.

3. Health

- TBS have helped in the revival of traditional system of medicine and the promotion of the Ayurvedic system of medicine. The local traditional healers have been empowered with the latest information on preparation, use and dissemination of herbal medicine.

4. Education

- The communities actively participate in supervision of the community schools and in motivating parents to send their children to schools.
- TBS encourages literate youths of villages to teach children in other villages lacking formal education infrastructure.
- TBS provide extensive training to the community teachers. TBS also helped Communities in the erection of educational-infrastructure like School Building, Furniture etc.
- TBS ran learning centres "Tarun Shalas" till 2005. They functioned simultaneously as alternative schools for children, as well as learning centres for adult women.

MILESTONES

1. Jan Jal Jodo Abhiyan

- Jal Jan Jodo campaign was launched in 2013.
- Jal Jan Jodo Abhiyan is a nationwide campaign with an objective to ensure water security, protecting ponds, lakes, and rivers through community participation.

- This movement acting as joint platform of civil society organizations, Government departments, Universities, Professors, lawyers, students, journalists, writers, NSS, NCC, volunteers & grass root water activists throughout the Nation.
- The campaign is also strengthening deprived and suppressed communities like Dalit, tribal, women population and empowering them to strengthen their voices to secure water rights.
- The main objective of the campaign is to connect people with water conservation issues. The campaign leaders believe that government schemes alone will not be able to end the water crisis in the country. People's participation and ownership is necessary.

2. Save The River Ganga Campaign

- Tarun Bharat Sangh under the leadership of Dr G.D.Agarwal (Vice Chairman of TBS) launched a nation-wide campaign to maintain an unaffected flow of the river Bhagirathi in Uttarakhand. He opposed the government policies to dam the river for power projects.
- The campaign influenced the Government of India (on February, 2009) to designate River Ganga as National river and notify the National Ganga River Basin Authority (NGBRA) as an empowered planning, financing monitoring and co-coordinating authority for the Ganga under the Environment (Protection) Act, 1986.

3. Tarun Jal Vidyapeeth (Tarun Water School)

- A need was felt to build the capacities of organisations and individuals working in the field of water conservation in India.
- The training provided in Tarun Jal Vidyapeeth (TJV) enhances the understanding and skills of those working or interested in working on issues of water management.
- The objective of setting up TJV is to raise a group of pupils who have a deep concern for water conservation.
- The trained leaders further take up the water governance agenda in their respective areas.

TJV has till now facilitated following activities:

- Two-year course for "Water Warriors".
- Short term capacity building course for all stakeholders in water management such as village institutions, NGOs, VO's, CBO's, GOs, Academicians, Scientists, bureaucrats, social activists etc.
- Organising State & National level workshops on vital issues related to water management and for working towards a more equitable and sustainable State Water Policy.
- Maintain and upgrade national mailing list and resource library on water.
- Publications of exemplary work and issues on water management.

4. Rashtriya Jal Chetna Yatra

The National Water Awareness Campaign was planned with the following objectives:

- To increase awareness about the need for judicious use and regeneration of water resources for enhancing water quality and quantity in all parts of India.
- To bring together activists who are working on water issues in isolated pockets of India.
- To establish dialogue with government making state and national water policies more people-oriented and responsive.

In 14 months, the campaign touched 320 districts in 30 states of India (of which 17 states are severely drought affected) and met concerned persons in 90 cities and 4 metropolises.

Issues that emerged during the yatra:

- ***Degradation of surface and groundwater resource***
- ***The unavailability of clean and potable drinking*** water

- ***Conflicts on water***
- ***Drastic decrease in Water availability for irrigation***
- ***The cost of production of agricultural and associated products is on the increase.***
- ***Negligence of Traditional Water Harvesting Systems***

5. Struggle Against Mining In Sariska National Park

- The mining activities were destroying not only the Aravalis (an oldest mountain range in the world), but the indiscriminate dumping was also causing damage to the Sariska National Park and endangering the lives of the wild animals. An ecological imbalance was setting in
- So, with one voice TBS protested, gathering villagers as they went on their long marchers to demonstrate the injustice. Nearly 45 organizations from other states supported the *yatra* as part of the *Save Aravalis Campaign*.
- A public interest petition was filed by TBS in the Supreme Court of India. In 1991, the court issued an order against continuing mining in the ecologically fragile Aravalis. This was followed up by a notification by the Ministry of Environment and Forests in May 1992 banning mining in the Aravalli hill system. It eventually led to the closure of 470 mines operating within the buffer area and periphery of the Sariska National Park.

6. River Arvari Parliament

- The Sansad represents 72 villages, each of which sends two representatives.
- The primary objective of the Sansad is to safeguard Integrated and Water Management efforts of the community.
- Thus Arvari Sansad develop policies and enforce rules to govern the integrated management of interlinked natural resources like water, soils and the forest for the wellbeing of the villagers as well as other forms of life-flora and fauna.

Important Awards

- In 2016, **The International Ahimsa Award** in Commons House of United Kingdom by Communities Minister of UK.
- In 2015, **The Stockholm Water Prize**, also known as "the Nobel Prize for Water".
- In 2008, **The Guardian** named him in its list of **"50 people who could save the planet"**.
- In 2005, The India's most prestigious **Jamna Lal Bajaj Award** for the Outstanding Contribution in Application of Science and Technology for Rural Development.
- In 2001, The Asia's most prestigious **Ramon Magsaysay Award** for the Community Leadership.

6a) ii) **Narmada Bachao Andolan**

Narmada Bachao Andolan is the most powerful mass movement, started in 1985, against the construction of huge dam on the Narmada river. Narmada is the India's largest west flowing river, which supports to large variety of people with distinguished culture and tradition ranging from the indigenous (tribal) people inhabited in the jungles here to the large number of rural population. The proposed Sardar Sarovar Dam and Narmada Sagar will displace more than 250,000 people. The big fight is over there settlement or the rehabilitation of these people.

Sardar Sarovar history

The Sardar Sarovar project was a vision of the first deputy prime minister of India, Sardar Vallabhbhai Patel. The foundation stone of the project was laid out by Pandit Jawaharlal Nehru on April 5, 1961 after carrying out a study on the usage of the Narmada river water

that flowed through the states of Madhya Pradesh and Gujarat and into the Arabian Sea. A project report prepared for the dam led to much dispute over the means of distributing the Narmada water among the three states- Gujarat, Maharashtra and Madhya Pradesh. As the negotiations bore no fruit, a Narmada Water Dispute Tribunal (NWDT) was created in 1969 to decide the fate of the project.

Benefits of project

The Sardar Sarovar Project will provide irrigation facilities to 18.45 lac ha. of land, covering 3112 villages of 73 talukas in 15 districts of Gujarat. A special allocation of 0.86 MAF of water has been made to provide drinking water to 131 urban centres and 9633 villages within and out-side command in Gujarat for present population of 28 million and prospective population of over 40 million by the year 2021. There are two power houses viz. River Bed Power House and Canal Head Power House with an installed capacity of 1200 MW and 250 MW respectively. The power would be shared by three states - Madhya Pradesh - 57%, Maharashtra - 27% and Gujarat 16%.It will also provide flood protection to riverine reaches measuring 30,000 ha. covering 210 villages and Bharuch city and a population of 4.0 lac in Gujarat.

Negative impact of project

In many countries large dams provide electricity, irrigation and water for drinking, and sanitation purposes. Infrastructure development strategies often neglect social and environmental impacts to affected peoples, flora and fauna. Sardar Sarovar Dam, one of the largest dam projects undertaken by the government of India, has displaced millions of people since the 1980s. This research assesses the economic, social and environmental impacts on resettled families due to construction of the Sardar Sarovar Dam. Under study was the resettlement of 1,500 families to Taloda taluka, in the state of Maharashtra. Government documents were reviewed for approximately 1,500 families; face-to-face interviews were conducted with 24 households from May to August 2008. Data analysis was performed using descriptive statistics, t-tests, correlation, and coding for qualitative responses to open-ended questions. It was found that families owned less livestock and land and grew fewer varieties of crops after resettlement. They did not see significant increases in income. Important cultural ceremonies were disrupted because extended families were dispersed due to resettlement. Many families who originally lived by the river missed their old riparian habitat since they were resettled in a markedly different environment.

Proponents of project

Narmada Bachao Andolan was initiated by Medha Patkar along with other colleagues. Medha Patkar is a graduate in social work, who moved to live among the tribals of the Narmada Valley in the mid-1980s and alerted them to the fate that awaited them with the dams. Having founded NBA, she remains one of its main catalysts, strategists and mobilisers. During the Narmada struggle, Patkar has faced repression and has been arrested several times, She also

undertook many Satyagrahas (pledge for truth) and long fasts. In a confrontation between NBA supporters and pro-dam forces in 1991, her 21-day fast brought her close to death.

Baba Amte, (1914-2008), was one of India's most respected social and moral leaders. Most of his life he devoted to the care and rehabilitation of leprosy patients. His community of a few thousand patients at Anandwan has done much to dispel prejudice against the victims of leprosy. In 1990 he left Anandwan with the words: "I am leaving to live along the Narmada… Narmada will linger on the lips of the nation as a symbol of all struggles against social injustice."

The decade-long struggle in the Narmada valley has resulted in suspension of the work on the Sardar Sarovar dam project through the movement as well as the Supreme Court's intervention. NBA questioned and compelled the World Bank that supported the dam with a US$ 450 million loan to review the Sardar Sarovar project. NBA has also exposed fraud in the environment compliance reports and massive corruption in the rehabilitation leading to a judicial inquiry. Even if the wall is complete (122 m high in 2009), the further erection of 17 m high radial gates was not permitted, due to non-compliance on rehabilitation and environmental measures. There are more than 200,000 people in the submergence area of this single dam with the best of agriculture and horticulture and all community life going on with temples, mosques, trees, schools, dispensaries, Government buildings etc.

Criticism

The Narmada dam's benefits include provision of drinking water, power generation and irrigation facilities. However, the campaign led by the NBA supporters have indulged in physical attacks on local people who accepted compensation for moving.

Others have argued that the Narmada Dam protesters are little more than environmental extremists who use pseudoscientific agitprop to scuttle the development of the region, and that the dam will provide agricultural benefits to millions of poor in India.

Conclusion

Even though the project is an excellent opportunity for our nation to excel and solve many of our current problems, it is also in some ways an invitation to many more. Thus, even if this project is essential, in the current circumstances and financial situation of the nation, it is unadvisable to go forward with it.

6b) i) **<u>"Project Tiger"</u>**

Intro: Wildlife animals in India are both rich and varied. More than 5% of India's land is under forest cover- there are more than 100 national parks and 482 wildlife sanctuaries. The country is one of the 12 mega diversity areas in the world, in terms of animals.

***Historical importance*:** Since about 2500 BC the Bengal tiger has been India's national symbol. First time it was displayed on the Pashupatinath seal of Indus valley civilisation around. There after it was the Royal symbol of the Chola Empire from. Now it is the national animal of India. The Indian tiger has been as a symbol of pride by Reserve Bank of India which has taken it as its emblem. Indian currency notes also have image of a tiger.

About the tiger:

The Weight of an adult male tiger can be 220 kg and female tiger weighs about 140 kg.

An Indian Tiger can digest up to 60 pounds of food at one time. It can survive them for around 3-4 weeks without food.

Project tiger:

- Project tiger is a very popular wildlife conservation project of India. It came into effect in 1973. Before that hunting of tigers was legal in India.
- The National Tiger Conservation Authority (NTCA) is a statutory body of the Ministry, with an overarching supervisory / coordination role, performing functions as provided in the Wildlife (Protection) Act, 1972.
- The Regional Offices of the NTCA have been recently established at Bengaluru, Guwahati and Nagpur.
- From 9 tiger reserves since its formative years, the Project Tiger coverage has increased to 47 at present, spread out in 18 of our tiger range states.
- The job of the project is to visualize the tiger reserves as breeding nuclei from there surplus tigers can immigrate to adjacent forests.
- The tiger reserves are constituted on a core/buffer strategy. The core areas have the legal status of a national park or a sanctuary, whereas the buffer or peripheral areas are a mix of forest and non-forest land, managed as a multiple use area. The Project Tiger aims to foster an exclusive tiger agenda in the core areas of tiger reserves, with an inclusive people oriented agenda in the buffer.

Current activities:

- Provides central assistance to States under the ongoing Centrally Sponsored Scheme of Project Tiger for 44 tiger reserves.
- This includes protection, habitat amelioration, day to day monitoring, eco-development for local people in buffer areas, voluntary relocation of people from core/critical tiger habitats, and addressing human-wildlife conflicts, within the ambit of the Wildlife (Protection) Act, 1972 and guidelines of Project Tiger / NTCA.
- The NTCA / Project Tiger also conducts the country level assessment of the status of tiger, co-predators, prey and habitat once in four years, using the refined methodology, as approved by the Tiger Task Force.

Special thrust on tiger protection and anti-poaching operations

- The illegal demand for body parts and derivatives of tiger outside the country continues to be a serious threat to wild tigers. Therefore, protection is accorded topmost priority in Project Tiger / NTCA.
- The States are engaged in issuing alerts, besides closely working with the CBI, Wildlife Crime Control Bureau and the Police Departments.

The following actions are taken in this context:

- Alerting the States as and when required.
- Transmitting information relating to poachers.
- Advising the States for combing forest floor to check traps.
- Performing supervisory field visits through the NTCA and its regional offices.
- Providing assistance to States for antipoaching operations.
- Using information technology for improved surveillance (e-Eye system) using thermal cameras.
- Launching tiger reserve level monitoring using camera trap to keep a photo ID database of individual tigers
- Preparing a national database of individual tiger photo captures to establish linkage with body parts seized or dead tigers.
- Assisting States to refine protection oriented monitoring through monitoring system for tiger's intensive protection and ecological status (M-STrIPES)
- Assisting States to deploy local workforce in a big way for protection to complement the efforts of field.
- Supporting States for raising, arming and deploying the Special Tiger Protection Force.

In several productive tiger landscapes, tigers move out from the core tiger habitats areas. This is an innate behaviour owing to their social dynamics. Since the tiger landscapes have human settlements and varied land uses, there are frequent human-tiger/ wildlife interface issues. The NTCA / Project Tiger is actively engaging with the States to address such issues and a SOP has been put in place in this regard.

The following steps are taken for this:

1. Stepped up protection/networking/surveillance.
2. Voluntary relocation of people from core tiger habitat to provide inviolate space for tigers.
3. Strengthening of infrastructure and habitat management as per Tiger Conservation Plans of tiger reserves.
4. Use of information technology in wildlife crime prevention.
5. Addressing human-wildlife conflicts.
6. Addressing the issue of resource dependency of local people through sustainable livelihood options.
7. Active management for rescuing moving tigers from human dominated landscape.
8. Strengthening the regional offices of the NTCA.
9. Declaring and consolidating new tiger reserves.
10. Fostering awareness for eliciting local public support.
11. Fostering Research.

Conclusion:

Due to concerted efforts under Project Tiger, at present India has the distinction of having the maximum number of **tigers in the world (2226) as per 2014 assessment,** when compared to the 13 tiger range countries.

The 2014 country level tiger assessment has also shown a 30% increase of tigers in the country (from 1706 in 2010 to 2226 in 2014).
70% of the world's tigers exist in India.
Robust Spatially explicit capture-recapture (SECR) models have been used to arrive at the current figure.
The NTCA / Project Tiger also conducts the country level assessment of the status of tiger, co-predators, prey and habitat once in four years, using the refined methodology, as approved by the Tiger Task Force.

6b ii)

GANGA ACTION PLAN

The Ganga action plan was, launched by Shri Rajeev Gandhi, the then Prime Minister of India on 14 Jan. 1986 with the main objective of pollution abatement, to improve the water quality by Interception, Diversion and treatment of domestic sewage and present toxic and industrial chemical wastes from identified grossly polluting units entering in to the river. The other objectives of the Ganga Action Plan are as under.

- Control of non-point pollution from agricultural runoff, human defecation, cattle wallowing and throwing of unburnt and half burnt bodies into the river.
- Research and Development to conserve the biotic, diversity of the river to augment its productivity.
- New technology of sewage treatment like Up-flow Anaerobic Sludge Blanket (UASB) and sewage treatment through afforestation has been successfully developed.
- Rehabilitation of soft-shelled turtles for pollution abatement of river have been demonstrated and found useful.
- Resource recovery options like production of methane for energy generation and use of aquaculture for revenue generation have been demonstrated.
- To act as trend setter for taking up similar action plans in other grossly polluted stretches in other rivers.
- The ultimate objective of the GAP is to have an approach of integrated river basin management considering the various dynamic inter-actions between abiotic and biotic eco-system.
- Notwithstanding some delay in the completion of the first phase of GAP it has generated considerable interest and set the scene for evolving a national approach towards replicating this program for the other polluted rivers of the country. The Government of India proposed to extend this model with suitable modifications to the national level through a National River Action Plan (NRAP). The NRAP mainly draws upon the lessons learnt and the experience gained from the GAP besides seeking the views of the State Governments and the other concerned Departments/Agencies.

- **Pollution of the Ganges** (or **Ganga**), the largest river in India, poses significant threats to human health and the larger environment. Severely polluted with human waste and industrial contaminants, the river provides water to about 40% of India's

population across 11 states, serving an estimated population of 500 million people or more, more than any other river in the world

- Today, the Ganges is considered to be the sixth-most polluted river in the world. Raghubir Singh, an Indian photographer, has noted that no one in India spoke of the Ganges as polluted until the late 1970s. However, pollution has been an old and continuous process in the river as by the time people were finally speaking of the Ganges as polluted, stretches of over six hundred kilometres were essentially ecologically dead zones.
- A number of initiatives have been undertaken to clean the river but failed to deliver as desired results. After getting elected, India's Prime minister Narendra Modi affirmed to work in cleaning the river and controlling pollution. Subsequently, the *Namami Gange* project was announced by the government in the July 2014 budget. An estimated Rs 2,958 Crores (US$460 million) have been spent until July 2016 in various efforts in cleaning up of the river.
- **National River Ganga Basin Authority (NRGBA)**

  NRGBA was established by the Central Government of India, on 20 February 2009 under Section 3 of the Environment Protection Act, 1986. It declared the Ganges as the "National River" of India. The chair includes the Prime Minister of India and chief ministers of states through which the Ganges flows. In 2011, the World Bank approved $1 billion in funding for the National Ganges River Basin Authority.

Causes:

The main cause of water pollution in the Ganga river are the increase in the population density, various human activities such as bathing, washing clothes, the bathing of animals, and dumping of various harmful industrial waste into the rivers.

Human waste

The river flows through 30 cities with populations over 100,000; 23 cities with populations between 50,000 and 100,000, and about 48 towns. A large proportion of the sewage water with higher organic load in the Ganga is from this population through domestic water usage.

Industrial waste

Because of the establishment of a large number of industrial cities on the bank of the Ganga like Kanpur, Allahabad, Varanasi and Patna, countless tanneries, chemical plants, textile mills, distilleries, slaughterhouses, and hospitals prosper and grow along this and contribute to the pollution of the Ganga by dumping untreated waste into it. One coal-based power plant on the banks of the Pandu River, a Ganga tributary near the city of Kanpur, burns 600,000 tons of coal each year and produces 210,000 tons of fly ash. The ash is dumped into ponds from which a slurry is filtered, mixed with domestic wastewater, and then released into the Pandu River. Fly ash contains toxic heavy metals such as lead and copper. The amount of parts per million of copper released in the Pandu before it even reaches the Gang is a thousand times higher than in uncontaminated water. Industrial effluents are about 12% of the total volume of effluent reaching the Ganga. Although a relatively low proportion, they are a cause for major concern because they are often toxic and non-biodegradable.

Religious traditions

During festival seasons, over 70 million people baths in the Ganga to clean themselves from their past sins. Some materials like food, waste or leaves are left in the Ganga which are responsible for its pollution. Traditional beliefs hold that being cremated on its banks and to float down the Ganga will atone for the sins of those who die and carry them directly to salvation. In Varanasi alone, an estimated forty thousand bodies are cremated every year, many of those are only half-burnt.

Effect:

Marine life

The results of mercury analysis in various specimens collected along the basin indicated that some fish muscles tended to accumulate high levels of mercury. Of it, approximately 50–84% was organic mercury. A strong positive correlation between mercury levels in muscle with food habit and fish length was found.

The Ganges River dolphin is one of few species of fresh water dolphins in the world. Listed as an endangered species, their population is believed to be less than 2000. Hydroelectric and irrigation dams along the Ganges that prevents the dolphins from travelling up and down river is the main reason for their reducing population. The Ganges softshell turtle (*Nilssonia gangetica*) is found in the Ganges, Indus, and Mahanadi river systems of Pakistan, northern India, Bangladesh, and southern Nepal. This turtle inhabits deep rivers, streams, large canals, lakes and ponds, with a bed of mud or sand. According to the International Union for Conservation of Nature, freshwater turtle species are vulnerable. Due to their long lifespan and high trophic level in the aquatic food web, turtles are vulnerable to heavy metals pollution, a major kind of pollution in the Ganges.

Wildlife

Some of the dams being constructed along the Ganges basin will submerge substantial areas of nearby forest. For example, the Kotli-Bhel dam at Devprayag will submerge 1200 hectares of forest, wiping out the forest area

Human beings

An analysis of the Ganges water in 2006 and 2007 showed significant associations between water-borne/enteric disease and the use of the river for bathing, laundry, washing, eating, cleaning utensils, and brushing teeth. Water in the Ganges has been correlated to contracting dysentery, cholera, hepatitis, as well as severe diarrhoea which continues to be one of the leading causes of death of children in India.

Namami Gange Programme

In the budget tabled in Parliament on 10 July 2014, the Union Finance Minister Arun Jaitley announced an integrated Ganged development project titled 'Namami Gange' (meaning 'Obeisance to the Ganges river') and allocated ₹ 2,037 crore for this purpose. The objectives were effective abatement of pollution, conservation, and rejuvenation of the Ganga. Under the project, 8 states are covered.

As a part of the program, government of India ordered the shutdown of 48 industrial units around the Ganges.

Significantly the approach is underpinned by socio-economic benefits that the program is expected to deliver in terms of job creation, improved livelihoods and health benefits to the vast population that is dependent on the river.

The main pillars of Namami Gange Programme are:

1. Sewerage Treatment Infrastructure
2. River-Front Development
3. River-Surface Cleaning
4. Bio-Diversity
5. Afforestation
6. Public Awareness
7. Industrial Effluent Monitoring
8. Ganga Gram

Its implementation has been divided into Entry-Level Activities (for immediate visible impact), Medium-Term Activities (to be implemented within 5 years of time frame) and Long-Term Activities (to be implemented within 10 years).

6c) i) Wildlife Protection Act – 1972

- **The Wildlife Protection Act**

1.1972 is an Act of the Parliament of India enacted for protection of plants and animal species. Before 1972, India only had five designated national parks

2. Among other reforms, the Act established schedules of protected plant and animal species; hunting or harvesting these species was largely outlawed.

3. The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto.

4. It extends to the whole of India, except the State of Jammu and Kashmir which has its own wildlife act.

5 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 the highest penalties

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- **Authorities to be appointed or constituted under the Act**

1. Appointment of Director and other officers
2. Appointment of Chief Wildlife Warden and other officers
3. Power to delegate
4. Constitution of the Wildlife Advisor-Y, Board
5. Procedure to be followed by the Board
6. Duties of the Wildlife Advisory Board

Laws of conservation

- The objectives of conservation and requirements for their achievement:

1. Maintenance of essential ecological processes and life-support systems.
2. Preservation of genetic diversity that is flora and fauna.
3. Sustainable utilization of species and ecosystems.

- Priorities for national action:

1. A framework for national and sub-national conservation strategies.
2. Policy making and the integration of conservation and development.
3. Environmental planning and rational use allocation.

- Priorities for international action:

1. International action: law and assistance.
2. Tropical forests and dry lands.
3. A global programme for the protection of genetic resource areas.

- Map sections:

1. Tropical forests.
2. Deserts and areas subject to desertification

(The Wildlife Conservation Act (1972) provides for the protection of wildlife and **c**onservation management, including the establishment and operation of National Parks.

The Act takes a conservative approach to wildlife management and does not make any provisions for involving local communities in management responsibilities or for sharing benefits of income generated from wildlife management (e.g. tourism or hunting fees). This Act was still under review in June 2013 and a new Act is expected to be presented before Parliament imminently.)

PROTECTION

(1) Animal" includes amphibians, birds, mammals and reptiles and their young, and also includes, in the cases of birds and reptiles, their eggs;

(2) "animal article" means an article made from any captive animal or wild animal, other than vermin, and includes an article or object in which the whole or any part of such animal [5][has been used, and ivory imported into India and an article made there from];

(3)"Board" means the Wild Life Advisory Board constituted under sub-section 1 of section 6;

(5) "captive animal" means any animal, specified in Schedule I, Schedule II, Schedule III or Schedule IV, which is captured or kept or bred in captivity;

(6) "Chief Wild Life Warden" means the person appointed as such under clause (a) of sub-section (1) of section 4;

[(7A) "circus" means an establishment, whether stationary or mobile, where animals are kept or used wholly or mainly for the purpose of performing tricks or manoeuvres;

(8) "Closed area" means the area which is declared under sub-section (1) of section 37 to be closed to hunting;

(9) "Collector" means the chief officer in charge of the revenue administration of a district;

(10) "Commencement of this Act", in relation to-

(a) A State, means commencement of this Act in that State,

(b) Any provision of this Act, means the commencement of that provision in the concerned State;

(11) "Habitat" includes land, water or vegetation which is the natural home of any wild animal;

6 c ii) ENVIORNMENT PROTECTION ACT, 1986

Environment Protection Act, 1986 19 nov and 26 sections in an act of the parliament of INDIA. In the wake of the Bhopal Tragedy, the government of India enacted the Environment Protection Act of 1986 under Article 253 of the constitution .

INTRODUCTION

An Act to provide for the protection and improvement of environment and formatters connected therewith.

Whereas the decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment.

The Environment(Protection) Act 1986 was introduced after the Bhopal gas tragedy during Rajiv Gandhi was the Prime Minister of our country.

OBJECTIVES

- To protect the forests and wildlife in the country
- To improve the quality of life by protection of life by protection of environment.
- To co-ordinate the activities of the various regulatory agencies already in existence.
- To appoint environment officers to check environmental pollution.
- Establishing environmental laboratories.

Definitions

Environment:

Environment it includes water , air and land and the interrelationship which exists between water, air and land and human being, other living creatures, plants,micro organisms and property.

Environment pollutant

It means any solid, liquid or gaseous substance present in such concentration as may be injurious to environment pollutant.

Hazardous substance

It means the presence of any environmental pollutant in the environment. It includes all extraneous materials that are harmful to human being , animal and plants life

Sources And Causes For The Polution

- Combustion
- Construction
- Mining
- Agriculture
- Chemical plants
- Coal – fired power plants
- Oil refineries
- Petrochemical plants , Nuclear waste
- Large livestock farms
- PVC factories
- Plastics factories and other heavy industry are increasingly significant in the pollution equation.

Rules to Regulate Environment Pollution

The Central Government may, by notification in the official Gazette, make rules in respect of all or any of the matters referred to in section 3.

a) The standards of quality of air, water or soil for various areas and purposes

b) The maximum allowable limits of concentration of various environmental pollutants (including noise) for different areas.

c) The producers and safeguards for the handling of hazardous substances.

d) The prohibition and restriction on the location of industries and the carrying on

Process and operations in different areas.

a) The procedures and safe guards for the prevention of accidents which may cause environmental pollution and for providing for remedial measures for such accidents.

6c) iii) THE NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000

The word noise is derived from the Latin term nausea. It has been defined as unwanted sound , a potential hazard to health and communication dumped into the environment with regard to the adverse effect it may have on unwilling ears.

Noise is defined as unwanted soundNoise- a sound; a harsh disagreeable sound, or such soun d; a din.

Pollution- an excessive or annoying degree of noise in a particular area, e.g. from traffic or ae ro plane engines.

1. Short-title and commencement.

(1) These rules may be called the 'Noise Pollution (Regulation and Control) Rules,2000 (2) T hey shall come into force on the date of their publication in the Official Gazette.

2. Definitions.- In these rules, unless the context otherwise requires,

(a) "Act" means the Environment (Protection) Act, 1986 (29 of 1986);

(b) "area/zone" means all areas which fall in either of the four categories given in the Schedule annexed to these rules;

(c) "authority" means any authority or officer authorised by the Central Government, or as the case may be, the State Government in accordance with the laws in force and includes a District Magistrate, Police Commissioner, or any other officer designated for the maintenance of the ambient air quality standards in respect of noise under any law for the time being in force;

(d) "person" in relation to any factory or premises means a person or occupier or his agent, who has control over the affairs of the factory or premises;

(e) "State Government" in relation to a Union territory means the Administrator thereof appointed under article 239 of the Constitution.

3. Ambient air quality standards in respect of noise for different areas/zones.

The Noise Pollution (Regulation and Control) Rules, 2000 - Ambient air quality standards.

(1) The ambient air quality standards in respect of noise for different areas/zones shall be suc h as specified in the Schedule annexed to these rules.

(2) The State Government may categorize the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.

(3) The State Government shall take measures for abatement of noise including noise emanati ng from vehicular movements and ensure that the existing noise levels do not exceed the amb ient air quality standards specified under these rules.

(4) All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall t ake into consideration all aspects of noise pollution as a parameter of quality of life to avoid n oise menace and to achieve the objective of maintaining the ambient air quality standards in r espect of noise.

(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area/zone for the purpose of these rules.

4. Responsibility as to enforcement of noise

1. The ambient air quality standards in respect of noise as specified in the Schedule.

(2) The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the ambient air quality standards in respect of noise.

5. Restrictions on the use of loud speakers/public address systems.

(1) A loud speaker or a public address system shall not be used except after obtaining written permission from the authority.

(2) A loud speaker or a public address system shall not be used at night (between 10.00 p.m. t o 6.00 a.m.) except in closed premises for communication within, e.g. auditoria, conference r ooms, community halls and banquet halls.

6. <u>Consequences of any violation in silence zone/area.</u>

Whoever, in any place covered under the silence zone/area commits any of the following offence, he shall be liable for penalty under the provisions of the Act:

(i) whoever, plays any music or uses any sound amplifiers,

(ii) whoever, beats a drum or tom-tom or blows a horn either musical or pressure, or trumpet or beats or sounds any instrument, or

(iii) whoever, exhibits any mimetic, musical or other performances of a nature to 44raq crowds.

7. <u>Complaints to be made to the authority.</u>

(1) A person may, if the noise level exceeds the ambient noise standards by 10 dB(A) or more given in the corresponding columns against any area/zone, make a complaint to the authority.

(2) The authority shall act on the complaint and take action against the violator in accordance with the provisions of these rules and any other law in force.

8. Power to prohibit etc. continuance of music sound or noise.

(1) If the authority is satisfied from the report of an officer in charge of a police station or other information received by him that it is necessary to do so in order to prevent annoyance, disturbance, discomfort or injury or risk of annoyance, disturbance, discomfort or injury to the public or to any person who dwell or occupy property on the vicinity, he may, by a written order issue such directions as he may consider necessary to any person for preventing, prohibiting, controlling or regulating:

(a) The incidence or continuance in or upon any premises of -

(i) Any vocal or instrumental music,

(ii) sounds caused by playing, beating, clashing, blowing or use in any manner whatsoever of any instrument including loudspeakers, public address systems, appliance or apparatus or contrivance which is capable of producing or re-producing sound, or

(b) The carrying on in or upon, any premises of any trade, avocation or operation or process resulting in or attended with noise.

(2) The authority empowered under sub-rule (1) may, either on its own motion, or on the application of any person aggrieved by an order made under sub-rule (1), either rescind, modify or alter any such order:

Provided that before any such application is disposed of, the said authority shall afford to the applicant an opportunity of appearing before it either in person or by a person representing him and showing cause against the order and shall, if it re+++++jects any such application either wholly or in part, record its reasons for such rejection.

SCHEDULE (see rule 3(l) and 4(l)

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) Leq *	
		Day Time	NightTime
(A)	Industrial area	75	70

(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.

2. Night time shall mean from 10.00 p.m. to 6.00 a.m.

3. Silence zone is defined as an area comprising not less than 100 metres around hospitals, educational institutions and courts. The silence zones are zones which are declared as such by the competent authority.

4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq : It is an energy mean of the noise level, over a specified period.