

AADIL SIR's Material

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Value Added Course

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Vision

“This course attempts to create pro-environment attitude and a behavioural pattern in student community and society that attaches importance and priority to create sustainable life style and awareness on various environmental issues. This course is expected to inculcate a critical thinking on various dimensions of environment through knowledge, skill, critical thinking and problem-solving”.

*Dedicated very Humbly
To My Beloved Parents
Whose blessings
brought me up to
here.....*

رَبِّ اَرْحَمُهُمَا كَمَا رَبَّيْتَنِي صَغِيرًا

Rabbir-ham-humaaKamaaRabbayaneesageera
(Verse 24, Surah - 17 Quran)

[O my Lord! Have mercy upon them, as they brought me up (when I was) small]

&

TEACHERS

(O my Lord! Have mercy upon my teachers)

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UNIT 1

UNDERSTANDING THE ENVIRONMENT

1.1 Environment: Concept, importance and components

Definition

"Environment' is derived from the French word “*environner*”, which means to encircle or surround. Each and every living organism has its specific surrounding, medium of environment to which it continuously interacts and remains fully adapted. The environment is the sum total of physical and biotic conditions influencing the responses of the organisms.

The Environment (Protection) Act, 1986 under section 2 defines the environment as *"the sum total of water, air and land and the interrelationships that exist among them and with the human beings, other living organisms and materials."*

Scope and Importance of Environmental Science

Environmental science is an interdisciplinary and multidisciplinary subject in its scope as shown in **Fig.1**. It enables us to understand the following main components of environmental management.

- Environment perception and people awareness.
- Control of environmental degradation and pollution.
- Control of over population and over consumption.
- Maintenance of environmental quality.
- To restrict and regulate the exploitation of natural resources.
- Helps us to participate in afforestation programmes.

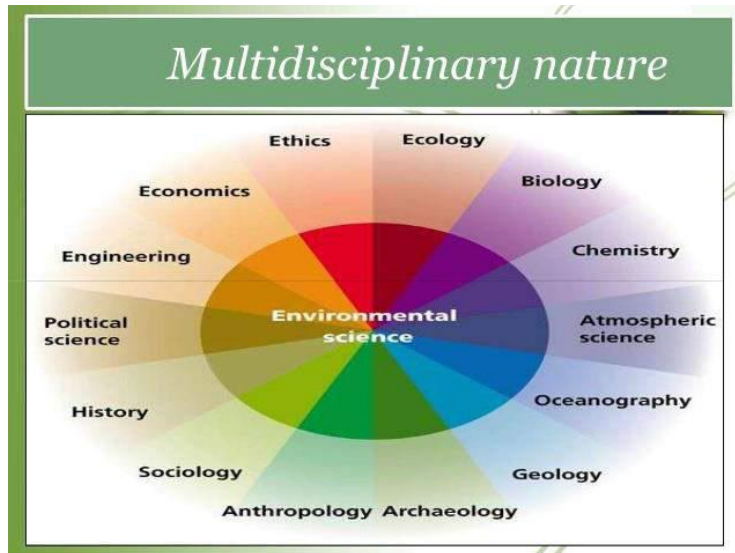


Fig 1: Multidisciplinary nature of environmental science

Importance of Environmental Science

The importance of Environmental Science may be summarized as:

- It helps us to study the design of environment, functions of nature and its coordination with living world.
- It develops an understanding that human beings, plants, animals are part of nature and dependent on each other.
- It high lights the effect of anthropogenic activities on natural processes.
- It develops the understanding that local environments can contribute in the protection and safety of global environment.
- It develops the responsibility among the people and concerned authorities to maintain ecological balance for a sustainable life.
- It makes a way for the participation of public in decision making and contribution in redressal of local and global environmental issues.

As a result, environment which is global in nature belongs to all and is thus important for all.

Components of Environment

The environment can be divided into two broad components as follows:

(i) Abiotic Environment: Physical environment is made up of the following states - solid, liquid, and gas. These three elements signify lithosphere, hydrosphere, and atmosphere respectively. This is also called the **Physical Environment**.

(ii) Biotic Environment: All living organisms around us viz. plants, animals, and microorganisms. This is also called the **Living Environment**.

Earth's environment can be further subdivided into the following four segments:

- A. Lithosphere
- B. B. Hydrosphere
- C. C. Atmosphere
- D. D. Biosphere

Atmosphere-The atmosphere refers to the protective blanket of gases, surrounding the earth. It sustains life on the earth. It saves the Earth from the hostile environment of the outer space.

Hydrosphere- Hydrosphere comprises all water resources such as ocean, seas, lakes, rivers, reservoirs, icecaps, glaciers, and ground water.

Lithosphere- It is the outer mantle of the solid earth. It contains minerals occurring in the earth's crust and the soil.

Biosphere- It constitutes the realm of living organisms and their interactions with the environment (atmosphere, hydrosphere, and lithosphere).

1.2 Ecosystem: Concept, structure and function (food chain, food web, ecological pyramids and energy flow)

Concept of Ecosystem

The term 'ecosystem' was coined by A.G. Tansley in 1935. An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components. In other words, ecosystem is defined as a group of plants, animals or living organisms living together and interacting with the physical environment in which they live.

An ecosystem has a more or less a closed boundary and the flow of mass in and out of the system are very less as compared to the internal movement of mass. Ecosystems can be large or small. Examples of large ecosystems are rain forests, deserts, salt marshes, coral reefs, lakes and ponds, open ocean, grass lands etc.

Types of Ecosystems

Ecosystems are classified as follows:

(1) Natural ecosystems (2) Man-made ecosystems

(1) **Natural ecosystem** is an assemblage of plants and animals which functions as a unit and is capable of maintaining its identity such as forest, grassland, an estuary, and human intervention is an example of a natural ecosystem. A natural ecosystem is totally dependent on solar energy. There are two main categories of ecosystems.

(i) **Terrestrial ecosystem:** Ecosystems found on land e.g. forest like (i) Tropical rain forests (ii) Tropical deciduous forests (iii) Temperate broad leaf forests (iv) Temperate needle – leaf or coniferous forests (v) Alpine and tundra forests. Apart from these, there are also some other types of forests are found in India like tidal forests, Himalayan vegetation, rain forests of southern India, desert region, etc. Deserts like (i) Thar deserts (ii) Rann of Kutch, grasslands, tundra.

(ii) Aquatic ecosystem: Plants and animal community found in water bodies. These can be further classified into two sub-groups.

(i) Fresh water ecosystem: Water on land which is continuously cycling and has low salt content is known as fresh water and its study is called limnology. It is of two types:

(a) Static water (Lentic) e.g. pond, lake, bogs and swamps.

(b) Running water (Lotic) e.g. springs, mountain brooks, streams and rivers.

(ii) Marine ecosystems, such as oceans, estuary.

(2) Man-made ecosystems

(a) Dependent on solar energy-e.g., agricultural fields and aquaculture ponds.

(b) Dependent on fossil fuel e.g. urban and industrial ecosystems.

Structure and function of an Ecosystem

The structure of an ecosystem is basically a description of the biotic and abiotic components of an ecosystem.

1. Biotic or living component

Biotic component includes all plants, animals and microorganisms living in an ecosystem. The biotic components can be classified into following groups depending on the way of obtaining food.

(a) Producers- Autotrophs (self nourishing): Autotrophs are also known as producers as they synthesize their own food from solar energy with the help of simple inorganic substances such as water and carbon dioxide and organic substances such as enzymes. The autotrophs are of two types.

(i) **Photo-autotrophs:** Which contain chlorophyll to convert the solar energy of sun into food e.g. trees, grasses, algae, phyto-planktons, photosynthetic bacteria and cyanobacteria (blue green algae).

(ii) **Chemo-autotrophs:** These are the organisms which produce their food through oxidation of certain chemicals. They are not dependent on the solar energy e.g. microorganisms such as beeggiatoa, sulphur bacteria etc.

(b) **Consumers- Heterotrophs or phagotrophs (other nourishing):** Heterotrophs are the organisms which lack the ability to synthesize their own food and have to depend on other organisms for nutrition. They are also known as consumers because they consume the materials built up by producers. These are further categorized as:

(i) **Primary consumers or herbivores:** The animals which feed on the producers or plants are known as herbivores. Examples; Sheep, cattle, deer, caterpillar, etc.

(ii) **Secondary consumers or primary carnivores:** The animals which feed on the herbivores are known as primary carnivores. Example; fox, snake, etc.

(iii) **Tertiary consumers:** The animals that feed on the secondary consumers or carnivores are known as tertiary consumers. Example; wolves etc.

(iv) **Quaternary consumers or Top carnivores:** These are the largest carnivores which feed on the tertiary, secondary as well as primary consumers and are not eaten up by any other animal. Example; lion and tiger

(v) **Omnivores:** They feed on both plants and animals. Example; Man, rat, crow etc

(c) **Decomposers- Micro consumers or Saprotrophs (or osmotrophs)** Decomposers are the organisms that feed on the dead organic matter of plants and animals and break down complex organic compounds of dead organisms. They are also known as reducers or saprotrophs. Example; bacteria, fungi, etc.

2. Abiotic or Non-living component

Abiotic component of the ecosystem comprises of three components:

(a) **Climatic condition and physical factors of the given region:** Such as pH, soil, temperature, light, precipitation, humidity, wind etc.

(b) Inorganic substances: They include water, minerals, and gases all of which are involved in cycling of materials in the ecosystem (i.e. biogeochemical cycles). The amount of these inorganic substances present at any given time in an ecosystem is called as the standing state or standing quality.

(c) Organic substances: Such as proteins, carbohydrates, lipids, etc. present either in the biomass or in the environment i.e. biochemical structures that link the biotic and abiotic component of the ecosystem.

Functions of an Ecosystem

Ecosystems are complex dynamic system. They perform certain functions. These are:

- (a) Food chain and food web
- (b) Nutrient cycling (biogeochemical cycles)
- (c) Productivity (primary and secondary)
- (d) Energy flow
- (e) Homeostasis (or cybernetic) or feedback control mechanisms

Food Chain

The transfer of food energy from green plants (producers) through a series of organisms, such as herbivores, carnivores and decomposers with repeated eating and being eaten is known as **food chain**. In other words, a list of organisms showing “**who eats whom**” is called as food chain e.g.

Grasses → Grasshopper → Frog → Snake → Hawk/Eagle

Each step in the food chain is called trophic level. A food chain has three main trophic levels viz. producers, consumers and decomposers. The energy efficiency of each trophic level is very low. Hence shorter the food chain greater will be the availability of food. In the above example grasses are 1st, and eagle represents the 5th trophic level.

Types of Food Chain

There are two types of food chains:

(i) **Grazing food chain:** This type of food chain starts from the green plants that make food for herbivores and herbivores in turn for the carnivores in **Fig.2**. Ecosystems with such type of food chains are directly dependent on an influx of solar radiation.

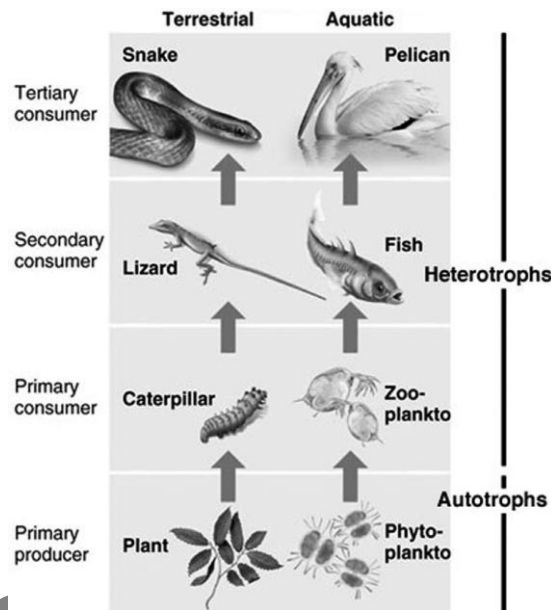


Fig.2: Grazing food chain

(ii) **Detritus food chain:** This type of food chain starts from the dead organic matter into micro-organisms and then to organisms feeding on detritus and their predators. Such ecosystems are thus less dependent on direct solar energy. A good example of this type of food chain is based on **mangrove leaves** described by Heald and Odum (1969).

Significance of food chain

- 1) It helps in understanding the feeding relations and interactions among different organisms of an ecosystem.
2. It explains the flow of energy and circulation of materials in ecosystems.
3. It helps in understanding the concept of biomagnifications in ecosystems.

Trophic Level

The various links or steps in a food chain at which the transfer of energy in an ecosystem is called as **trophic level**. There are basically four levels to the food chain viz. producers, primary consumers, secondary consumers, and tertiary consumers in **Fig 3**.

(i) **First Trophic Level** (Plants) Producers or Autotrophs produce all of the available food. They make up the first trophic (feeding) level. They possess the highest biomass (the total weight of all the organisms in an area) and the greatest numbers. This is evident from the fact that the plants make around 99 percent of the earth's total biomass.

(ii) **Second Trophic Level** (Herbivores or Primary Consumers) Primary consumers (Herbivores) are organisms that directly feed on producers. A good example is a cow. They make up the second trophic level.

(iii) **Third Trophic Level** (Carnivores or Secondary Consumers) The next level consists of organisms that feed on primary consumers. They are the secondary consumers, and they make up the third trophic level. They are called carnivores and omnivores.

(iv) **Fourth Trophic Level** (Apex Predators or Tertiary Consumers) Apex predator species occupy the highest trophic level(s) and have a crucial role in maintaining the health of their ecosystems. Apex predators affect prey species' population dynamics. Where two competing species are in an ecologically unstable relationship, apex predators tend to create stability if they prey upon both. Inter-predator relationships are also affected by apex status.

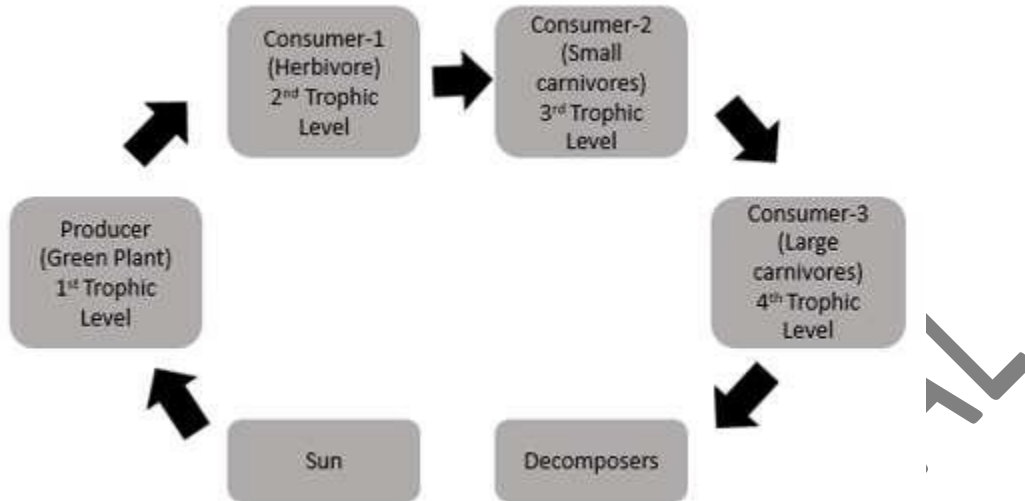


Fig.3: Four basic trophic levels

Food Web

The word ‘web’ means network. In an ecosystem, the various food chains which are interconnected with one another to form a network are called as **food web**. In other words, the interlocking of many food chains is called as food web in **Fig.4**. For example, a hawk that eats owls. Each food chain ends with a top predator and animal with no natural enemies (such as an alligator, hawk, or polar bear).

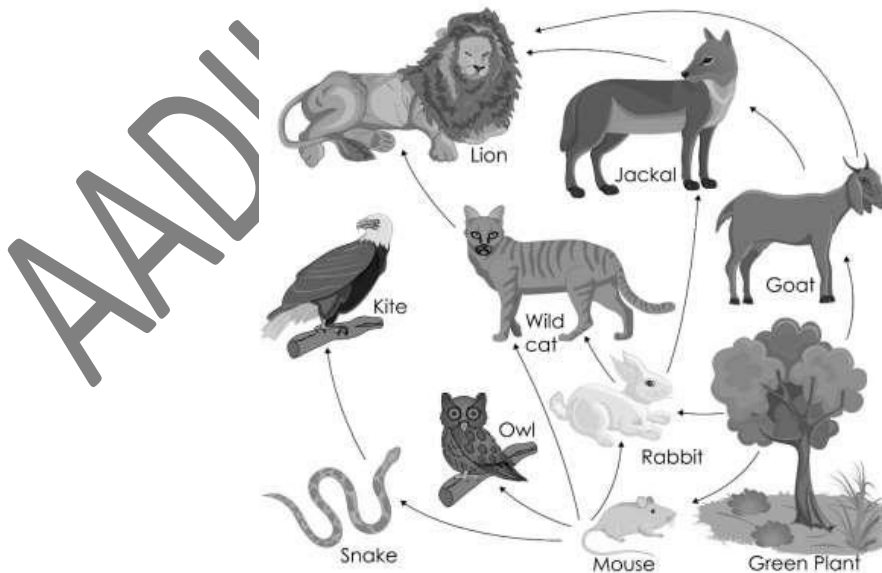


Fig.4: Food webs

Food webs are more complex and are interlinked at different trophic levels. This means that organisms have more than one alternative for food and hence survivability is better. Hawks don't limit their food to snakes, snakes eat things other than mice, and mice eat grass as well as grasshoppers, and so on.

Characteristics of food web

1. Unlike food chains, food webs are never straight.
2. Food web is formed by interlinking of food chains.
3. A food web provides alternative pathways of food availability.
4. In food web, greater are the alternative pathways more stable is the ecosystem.
5. Food webs also help in checking the overpopulations of highly fecundated species of organisms (both animals and plants).

Ecological Pyramid

Definition:

Ecological pyramid is a structure which expresses the food or energy relationship between organisms at different trophic levels. Thus, Ecological pyramid may be defined as “the number, biomass and energy of organisms gradually decrease from the producer level to the consumer level and can be represented in the form of a pyramid or graphical representation called as **ecological pyramid**”. In the ecological pyramid, producers from the base and the final consumer occupies the apex. Charles Elton (1927), an English biologist, developed the idea of ecological pyramids. Therefore, it is also termed as **Eltonian pyramid**.

Types of Ecological Pyramids

There are three types of ecological pyramids:

Pyramid of number: This represents the number of organisms at each trophic level. For example in grassland the number of grasses is more than the number of herbivores that feed on them and the number of herbivores is more than the

number of carnivores. In some instances the pyramid of number may be inverted, i.e herbivores are more than primary producers as you may observe that many caterpillars and insects feed on a single tree. It can be **upright or inverted**.

Pyramid of biomass: This represents the total standing crop biomass at each trophic level. Standing crop biomass is the amount of the living matter at any given time. In most of the terrestrial ecosystems the pyramid of biomass is upright. However, in case of aquatic ecosystems the pyramid of biomass may be inverted It can be **upright or inverted**.

Pyramid of energy: This pyramid represents the total amount of energy at each trophic level. Energy pyramids are never inverted. It is always **upright** in Fig.5.

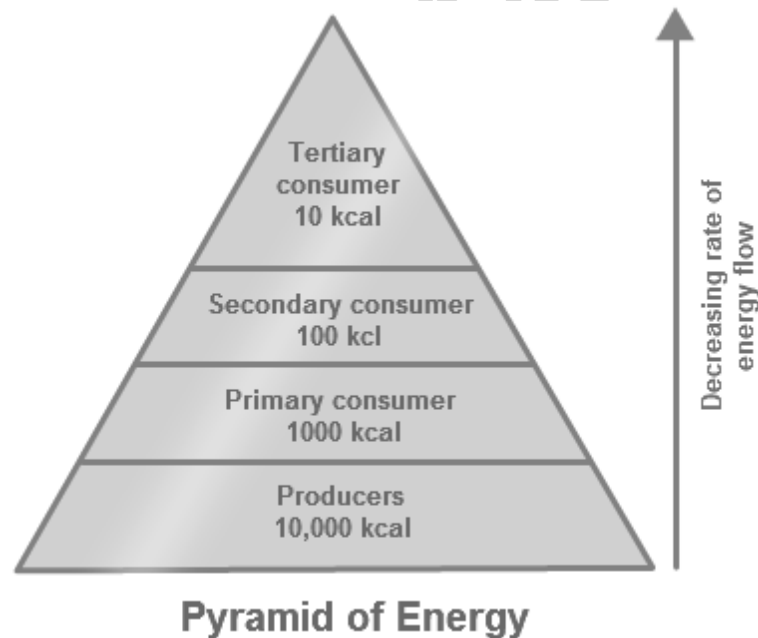


Fig.5: Pyramid of energy always upright

Energy Flow in an Ecosystem

Energy flows from one organism to another in an ecosystem in a unidirectional manner from lower trophic levels to higher levels. Flow of energy in an ecosystem takes place through the food chain and it is this energy flow which keeps the ecosystem going. The most important feature of this energy flow is that it is **unidirectional manner** or **non-cyclic manner** or **one-way flow**. Unlike the nutrients (like carbon, nitrogen, phosphorous) which move in a cyclic manner, energy is not reused or recycled in the food chain. The flow of energy in an ecosystem follows the two laws of thermodynamics:

1st Law of thermodynamics: It states that energy can neither be created nor be destroyed but it can be transformed from one form to another. The solar energy captured by the green plants gets converted into biochemical energy of plants and later into that of consumers.

2nd Law of thermodynamics: It states that energy dissipates as it is used or in other words, it gets converted from a more concentrated form to dispersed form. As energy flows through the food chain, there occurs dissipation of energy at every trophic level. The loss of energy takes place through respiration, locomotion, running and other activities. At every level there is about 90% loss of energy and the energy transferred from one trophic level to the other is only about 10% called as **Lindeman's 10% law**.

According to this law, “only 10% of total amount of energy stored or accumulated in a specific or particular trophic level is transferred to next trophic level in a food chain”.

1.3 Ecosystem Services

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on earth.

1. Economic or Provisioning Services

These are the products obtained from ecosystems, including:

- Food and fibre
- Fuel wood
- Genetic resources
- Medicines, and pharmaceuticals
- Ornamental resources
- Fresh water

2. Ecological and Regulating Services

These are the benefits obtained from the regulation of ecosystem processes, including:

- Air quality maintenance
- Climate regulation
- Water regulation
- Erosion control
- Water purification and waste treatment
- Ground water recharge
- Regulation of human diseases
- Pollination
- Storm protection

3. Social and Cultural Services

These are the services of the ecosystem associated with social life, customs, religion etc including:

- Cultural diversity
- Spiritual and religious values
- Knowledge systems
- Educational values
- Inspiration
- Social relations
- Cultural heritage values
- Recreation and ecotourism

AADIL SIR'S MATERIAL

1.4 Biodiversity: levels, values and threats and conservation

Definition

Bio = life/living beings; Diversity = Variations/variety

It is defined as “variety or variability among living organisms and variety among the ecosystems in which they live, is known as biodiversity”.

Article-2 of the Convention on Biodiversity defines: “The variability among living organisms from all sources (ecosystems and ecological complexes). This includes variability within species, between species and of ecosystems”.

The term ‘Biodiversity’ was coined by Walter G. Rosen in the national forum on Biodiversity held in Washington D.C. in 1986. Biodiversity is now an international buzzword through its use in the Biodiversity Convention which has been agreed on by the UNCED.

Levels of Biodiversity/ Types of Biodiversity

Biological diversity is usually considered at three different levels – a) genetic diversity i.e. at genetic level, b) species diversity i.e. at the level of species, and c) ecosystem diversity i.e. at the level of ecosystem.

(a) Genetic diversity: Variation of genes within the individuals of single species.

Examples: Human beings (*Homo sapiens*) are one species. Difference of genes in different human beings. One human is different from other in size, shape, color, height, behavior, etc. This is the genetic diversity of human beings.

Another example, all rice varieties belonging to the species *Oryza sativa*, but there are thousands of wild and cultivated varieties of rice which show variations at the genetic level and differ in their color, size, shape, aroma and nutrient content of the grain. This is the genetic diversity of rice.

(b) Species Diversity: Variations among the species in ecosystem i.e. different types of species exist. It involves variety of species within a community or a region. It is the most fundamental unit of measuring biodiversity. Simplest measure

of the species diversity is the species richness i.e., a count of numbers of species presents in an area and species evenness i.e. the number and kind of species as well as the number of individuals per species. Thus every organism and their different varieties are included under species diversity.

(c) **Ecosystem diversity:** It includes different types of ecosystems whether small or large present on planet earth. Ecosystem diversity has three perspectives; alpha beta and gamma diversity and it describes the number of niches, trophic levels and various processes that sustain ecosystem functions in terms of energy flow and recycling of nutrients.

Values of biological diversity

The various benefits of biological diversity can be grouped under three categories: a) ecosystem services, b) biological resources, and c) social benefits.

(a) Ecosystem Services

- **Protection of water resources** like maintenance of hydrological cycles, regulating and stabilizing water runoff, and buffer against extreme events such as flood and drought.
- **Soils formation and protection:** Formation and maintenance of soil structure and the retention of moisture and nutrient levels.
- **Nutrient storage and cycling:** Plants take up nutrients from the soil as well as from the air, and these nutrients can then form the basis of food chains, to be used by a wide range of other life forms.

(b) Biological Resources

- **Food:** Existence of human beings and that of most other organisms is heavily dependent on primary producers, mainly plants.
- **Medicinal resources:** Plant and animal products have long since been used as medicines due to their curative properties.

- **Wood products:** Wood is a basic commodity used worldwide. It is a primary source of fuel, is used in construction, and forms the basis for paper production.

(c) Social Benefits

- **Research, education and monitoring:** Natural areas provide excellent living laboratories for research in ecology and evolution.

- **Recreation:** Diverse biological assemblies like animal habitats, forests, mountains, parks and gardens, coastal areas and beaches, provide aesthetic beauty to our environment.

- **Cultural values:** The aesthetic values of our natural ecosystems and landscapes contribute to the emotional and spiritual well-being of human beings.

Threats of biodiversity

Following are the major causes of threat to biodiversity.

- Habitat destruction/loss
- Habitat fragmentation
- Hunting
- Poaching of wildlife,
- Introduction of exotic (foreign) species
- Pollution

(i) **Habitat Destruction:** Destruction of habitats by humans is the largest causes of loss of biodiversity. The greatest destruction of biological communities is caused due to expansion of human activities and human population. As per JUCN, UNEP- report (1986), more than 50% of the wild life habitats have been destroyed in the old world tropical countries and there are high rates of destruction going on in Asian countries like Sri Lanka, Bangladesh and India too. Most of the habitat destruction has been caused in recent times due to rapid expansion of human

population and human activities like mining, deforestation, expansion of agriculture, constructions, all have caused a great threat to the world biodiversity.

(ii) **Habitat Fragmentation:** Sometimes the loss of habitat is in installments so that the habitat is divided into small and scattered patches, a phenomenon known as habitat fragmentation. Due to habitat fragmentation many song birds are vanishing.

(iii) **Hunting:** Animals are killed for enjoyment to provide food is known as hunting.

(iv) **Poaching of Wildlife:** Illegal trading of animals to obtain useful and costly materials is known as poaching. Poaching of wildlife for trade and commercial activities has been on the rise for the last many decades. It has been a significant cause of the extinction of hundreds of species and the endangerment of many more, such as whales and many African large mammal, Asian tigers, etc. Most extinction over the past several hundred years is mainly due to overharvesting for food, fashion, and profit. Illicit trade in wildlife in current times is driving many species of wild animals and plants to extinction. Elephants are poached for ivory; tigers and leopards for their skin; pangolins for meat and scales; and rare timber is targeted for hardwood furniture.

(v) **Introduction of exotic (foreign) species:** Plants and animals introduced in an ecosystem are known as exotic species. They are the new species introduced in an ecosystem. Thus, they grow and reproduce fast due to less environmental resistance e.g, no predators (animals who eat them) are there.

(vi) **Pollution:** High temperature is caused by global warming and climate change. Polar bear and penguins cannot survive at high temperature. They are under threat and becoming extinct.

Conservation of Biodiversity

It is defined as the preservation or management of natural resources so as to enhance or increase their life span. Conservation of biodiversity is important to: prevent the loss of genetic diversity of a species, save a species from becoming extinct, and protect ecosystems damage and degradation.

Conservation efforts can be grouped into the following two categories:

1. In-situ (on-site) conservation includes the protection of plants and animals within their natural habitats or in protected areas. In other words, it emphasise the protection of total ecosystems. Examples are National Parks, Sanctuaries, Biosphere Reserves, etc.

2. Ex-situ (off-site) conservation of plants and animals outside their natural habitats. It is mainly done for conservation of crop varieties. These include botanical gardens, zoo, gene banks, seed banks, tissue culture and cryopreservation.

(a) National Park

- It is an area reserved and maintained by a national government for the betterment of wildlife, where forestry, grazing or cultivation is prohibited.
- The National Parks are gateway to conservation ethics.
- Private ownership rights and habitat manipulation are not permitted.
- Boundaries are fixed by legislation.
- Each NP usually aims at conservation specifically of some particular species of wildlife along with others.
- It ensures high degrees of protection as the activities like hunting, fuel wood collection, extraction of other resources, grazing or agricultural activity are not permitted in such area.
- Jim Corbett NP was the first NP established in India.

- There are about 106 National parks in Indian. Some of the main National Parks in India are:

National Parks	State	Dominant Species
Bandipur NP	Karnataka	Elephant, tiger
Dachigam NP	Srinagar (Kashmir)	Hangul, black-bear
Gir NP	Gujarat	Asiatic-lion, panther
Hemis NP	Leh/Ladakh	Musk-deer, yak
Kanha NP	Madhya Pradesh	Tiger, hyena
Kaziranga NP	Assam	One-horned rhino, tiger
Silent Valley NP	Kerala	Elephant, panther

(b) **Sanctuaries**

- A sanctuary is meant for the conservation of the wild animals, only.
- It is an area where killing, hunting, shooting, capturing of any species of bird or animal is prohibited except by or under the control of the highest authority and whose boundaries should be sacrosanct as far as possible.
- The sole aim of sanctuary is the provision of maximum protection, preservation and conservation of the wild animals as it is generally species oriented.
- The degree of protection in a sanctuary is less than that of National park as the activities like grazing, wood collection, resources extraction, agriculture or even human settlements are permitted in such an area.
- There are about 565 sanctuaries presently in India established in different states. Some of them are given below along with important species found there.

Wildlife Sanctuaries	State	Dominant Species
Abohar WS	Punjab	Black buck, jackal
Ghana Bird Sanctuary	Rajasthan	Pied kingfisher, black bittern
Hazaribagh Sanctuary	Jharkhand	Tiger, leopard
Mudamalai WS	Tamil Nadu	Tiger, elephant
Overa-arua WS	Anantnag (Kashmir)	Brown-bear, leopard
Nandini WS	Jammu	Rhesus monkey, grey langur
Wild Ass Sanctuary	Gujarat	Wild ass, wolf

Functions of National Parks and Wildlife Sanctuaries

(i) Biodiversity preservation

Gene resources, Species protection, Ecosystem diversity, Evolutionary processes

(ii) Ecological processes

Fixing and cycling of nutrients, Soil formation, Circulation and cleansing of air and water, Global life support, Plants absorb CO₂ , give out O₂; Water balance

(iii) Watershed protection

Erosion control, Local flood reduction, Regulation of stream flows

(iv) Consumptive benefits

Fuel wood, Fodder, Fibre

(v) Non-consumptive benefits

Aesthetic, Spiritual, Cultural/historical, Existence value

(c) **Biosphere Reserves**

Biosphere reserve programme was launched by UNESCO in 1971 under its MAB (Man & biosphere) programme to conserve in situ all forms of life along with its support systems in totality. A biosphere reserve is an international network of preserved areas designated by UNESCO as these are important centres of biodiversity with research and monitoring activities being conducted with local community participation with the aim to protect and preserve healthy natural systems threatened by anthropogenic activities. Presently, 727 biosphere reserves have been established in 131 countries with 18 being setup in our country. Nilgiri was the first established in India in 1986. Out of the 18 Biosphere Reserves, 7 Biosphere Reserves have been included in the World Network of Biosphere Reserves so far. These include Nilgiri, Nanda Devi, Sunderban, Gulf of Mannar, Panchmarhi, Simlipal and Nokrek.

Zone of Biosphere Reserve

A Biosphere Reserve consists of core, buffer and transition zones.

(a) The **core zone** is fully protected and natural area of the Biosphere Reserve least disturbed by human activities. It is legally protected ecosystem in which entry is not allowed except with permission for some special purpose.

(b) The **buffer zone** surrounds the core zone and is managed to accommodate a greater variety of resource use strategies, and research and educational activities.

(c) The **transition zone**, the outermost part of the Biosphere Reserve, is an area of active cooperation between the reserve management and the local people, wherein activities like settlements, cropping, forestry, recreation and other economic that are in harmony with the conservation goal in **Fig.6**.

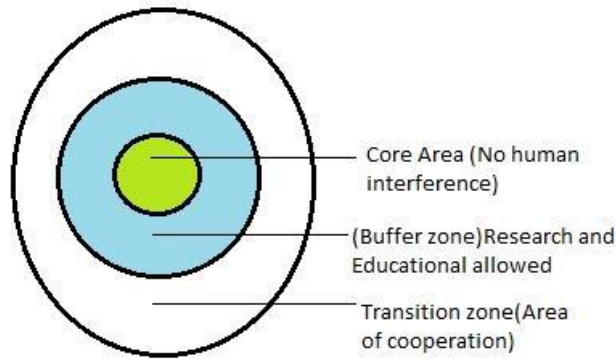


Fig.6: Zone of Biosphere Reserves

Functions of the Biosphere Reserves

The main functions of the biosphere reserves are:

Conservation: Long term conservation of representatives, landscapes and different types of ecosystems, along with all their species and genetic resources.

Development: Encourages traditional resource use and promote economic development which is culturally, socially and ecologically sustainable.

Scientific research, monitoring and education: Support conservation research, monitoring, education and information exchange related to local, national and global environmental and conservation issues.

2. Ex-situ Conservation

(a) **Botanical Gardens:** These are those areas where plants are kept safe when these face a severe threat in the wild.

(b) **Seed Banks:** Seed banks are places where seeds are deposited into secure storage with the intention of withdrawing them in the future when needed.

(c) **Gene Banks:** The genetic diversity of our crops is preserved in the form of seeds or cuttings in case of vegetative reproducing plants and subsequently this material is made available together with other important information for use in research and plant breeding in future.

(d) **Cryopreservation:** Cryopreservation (“freeze preservation”) is a technique where cells, tissues, organelles, organs etc susceptible to damage are preserved by cooling to very low temperatures (-80°C using solid CO_2 or mostly using liquid Nitrogen at -196°C). At such temperatures, most of the enzymatic activities which might cause damage to the biological material are effectively stopped and the genetic material is stored with an aim to conserve the breed and to preserve structurally intact cells and tissues.

AADIL SIR'S MATERIAL

1.4 Concept and objectives of environmental education, environmental ethics

Definition

"For the purpose of this Act, the term 'Environmental Education' means the educational process dealing with man's relationship with his natural and man-made surroundings and includes the relation of population, pollution resource allocation and depletion, conservation, transformation, technology and urban and rural planning to the total human environment".

Environmental education is a process by which people develop awareness, concern, and knowledge of the environment and learn to use this understanding to preserve, conserve and utilize the environment in a sustainable manner for the benefit of the present and future generations.

Conclusion: *In the light of various definitions of environmental education it can be concluded that environmental education is education 'about' the environment, 'from' the environment, 'through' the environment and 'for' the environment.*

Goals and Aims of Environmental Education

The goals of Environmental Education are:

1. To improve the quality of Environment.
2. To create awareness among the people on environmental problems and conservation.
3. To create an atmosphere so that people participate in decision-making and develop capabilities to evaluate the developmental programs.

Objectives of Environmental Education

The main objectives of Environmental Education are given below:

- **Awareness**-to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

- **Knowledge**– to help social groups and individuals gain a variety of experience in, and to acquire a basic understanding of, the environment and its associated problems
- **Attitudes**-to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
- **Skills**-to help social groups and individuals acquire the skills for identifying and solving environmental problems.
- **Evaluation ability**- to evaluate environs measures and education programmers in terms of social, economic, ecological and aesthetic factors.
- **Participation**-to provide social groups and individuals with an opportunity to actively involve at all levels in working toward resolution of environmental problems in **Fig.7**.



Fig.7: Objectives of environmental education

Ethics

Ethics is derived from the Greek word ‘*ethos*’ which means character i.e., concerned with behavior of man. Ethics is the discipline concerned with morality and moral obligations of a person with emphasis on the determination of what is right and what is wrong for nature and natural creatures.

Environmental Ethics

Environmental ethics refers to the issues, laws and instructions relating to the human relation owing to their environment. It is believed that humans are a member of society as well as other living creatures which includes plants and animals. Nature has existed not for humans separate but for all the species i.e., every species in this world has a birth right to live because all organisms are together on each other in a natural phenomenon so called a mutual relationship. As a result, each species plays a critical role in preserving the ecological equilibrium. Thus, if we obliterate any kind of diversity it would disrupt the ecological balance which is totally suicidal to environmental ethics. It all depends on how do we *think and act*.

Conclusion point of Environmental Ethics

- *Accessible documentation signifies those technical answers have not been resulting in agreeable conclusions, so environmental ethics is getting more concentration to find a proper solution for expansive environmental deterioration. Thus, it concludes when environmental ethics is based on an Islamic theocentrism and theology, it is feasible to have more inclusive and holistic come up towards the conservation of the natural surroundings. So, there is a need to increase ethical and moral values, philosophical thinking, action-oriented steps and moral development in education system.*

UNIT 2

NATURAL RESOURCES AND ENVIRONMENTAL POLLUTION

2.1 Natural Resources: Renewable and Non-renewable resources

The term “**resource**” means anything that we use from our environment to achieve our objective. A resource can be defined as ‘any natural or artificial substance, energy or organism, which is used by human being for its welfare. In other words, *“a resource is anything useful or can be made useful to humans to meet their needs and wants. The resource that is directly available from nature is called natural resource”*, which includes fresh air, fresh water in lakes and rivers, soil, land, forest, grasslands, biodiversity, fisheries, ecosystems, minerals, salts, fossil fuels and others.

Classification of Natural Resources: Natural resources can be categorized as renewable or non-renewable in Fig.8.

Renewable resources are ones that can be replenished naturally. Some of these resources, like sunlight, air, wind, etc., are continuously available and their quantity is not noticeably affected by human consumption. Renewable resources are also known as inexhaustible resources or Non-Conventional Sources of Energy. These include energy sources like solar radiation, wind power, water power (flowing streams) and tidal power, and substances like sand, clay, air, water in oceans, etc.

Non-renewable resources are resources that form extremely slowly and those that do not naturally form in the environment. Minerals are the most common resource

included in this category. Non-renewable resources are also known as exhaustible resources or Conventional Sources of Energy.

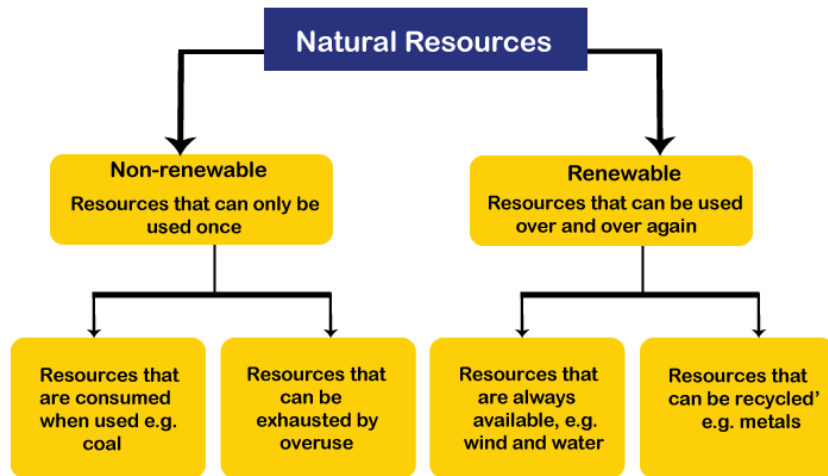


Fig.8: Natural resources can be categorized as renewable or non-renewable

1. Conventional Sources of Energy

Let's first discuss about the conventional sources of energy. These have been in use since ancient times. Most important among them are the fossil fuels. So we shall know details about the fossil fuels.

Fossil Fuels: Fossil fuels are the fossilized remains of plants and animals, which over millions of years have been transformed into coal, petroleum products and natural gas.

Coal is the most abundant fossil fuel. It is widely used for combustion in cooking and industrial activities. There are different types of coal products such as coal gas, coal tar, benzene, toluene, etc., which are used for various purposes.

Oil and Natural gases are formed from plants and animals which once lived in the tropical seas. Oil (or petroleum) is a source of countless products. Apart from petrol, diesel and other fuels, petroleum products include lubricants, waxes, solvents, dyes, etc. Petroleum reserves are supposed to last for another 100 years or so.

Natural gas is often found with petroleum. The gas mainly contains methane. Apart from serving as fuel in several industries, it is being increasingly used as domestic fuel in many countries including India. United States of America is the largest producer as well as consumer of natural gas.

Now a days in big cities and town it is being supplied through pipelines which is called **Piped Natural Gas (PNG)**. The natural gas is also used as a fuel to run vehicles. It is known as

Compressed Natural Gas (CNG). It is accepted as an economical and less polluting fuel for transport.

The **Liquefied Petroleum Gas (LPG)** is the common cooking gas used in Indian homes. It is a mixture of propane and butane gases kept under pressure in liquid form, but they burn in gaseous form. This gas is made available in a specific container for domestic as well as industrial uses. It is a byproduct of petroleum refineries.

2. Non-Conventional Sources of Energy

Solar Energy

Solar energy is the ultimate source of all energies on earth. Firewood, coal, oil or natural gas are the products of plants and other organisms, which had used solar energy for the synthesis of organic molecules during photosynthesis. Even today it will turn out to be the most important answer to problems of energy except nuclear energy. The solar energy has the following advantages:

- (i) It is abundant
- (ii) It is everlasting
- (iii) It is available almost everywhere.
- (iv) It is free from political barriers.

Various technologies in which solar energy can be, and is being utilized are as follows:

- (i) Solar cookers
- (ii) Solar hot water systems
- (iii) Solar dryers (used for drying crop yields)
- (iv) Solar air heaters
- (v) Solar kilns

Hydel /Hydro Energy: The generation of electricity by using the force of falling water is called hydroelectricity or hydel power. It is cheaper than thermal or nuclear power. For its generation dams are built to store water, which is made to fall to rotate turbines that generate electricity.

Wind Energy: Wind as an energy can be utilized in our daily life by converting it into mechanical energy. This mechanical energy is used to generate electricity, raise water from wells and rivers for irrigation and other purposes. Windmills have been in use since early times to provide power for grinding grains. It is also used for grain cutting and shelling. In India a large number of windmills are being constructed on the sea beach and hilly areas.

Tidal Energy: Tidal energy is one that is produced by making the use of water movement from a high tide to a low tide. Ocean waves and tides can be made to turn a turbine and generate electricity. Areas where rivers flow into the sea experience waves and tides and electricity can be generated there. It has much potential. As you know we have a large coastline and major river systems in our country, electricity can be generated on a large scale from waves and tides.

Nuclear Energy: Radioactive elements like uranium and thorium disintegrate spontaneously releasing large quantities of energy. This energy can be trapped to produce electricity. 25% of world's thorium reserve is found in our country, which can be utilized to generate electricity. Most advanced countries have nuclear power stations. We too have some in India, for example, Tarapur (Maharashtra), Kalpakkam (Tamil Nadu), Narora (Uttar Pradesh), Kota (Rajasthan).

Hydrogen Energy: Hydrogen is the primary fuel for the hydrogen based fuel cells and power plants. Power can be generated for industrial, residential and transport purposes by using hydrogen.

Geothermal Energy: This is the energy derived from the heat in the interior of the earth. In volcanic regions, springs and fountains of hot water called “geysers” are commonly found. These eruptions of hot steaming water can be used to turn turbines and produce electricity in geothermal power plants. In this method cold water is allowed to seep through the fissures in the rocks till it reaches the hot rocks in the lower layers. Water gets heated and gets converted into steam which forces out to the surface to be used in power generation.

Distribution of Key Natural Resources in the World

It has been seen that most of the countries in the world are having natural resources. Some have fewer amounts while other countries are rich in particular natural resource. Economists stated that natural resources add wealth to nations. When it is evaluated for resource distribution around the world, Australia has many natural resources. These resources include mineral resources, such as copper, gold and diamonds, energy resources, such as coal, oil, and uranium, and land resources that are used for farming and logging. These resources are financially important to Australia.

Distribution of Natural Resources in India

India is gifted with various types of natural resources such as fertile soil, forests, minerals and water. These resources are unevenly distributed. The Indian continent covers a multitude of biotic and abiotic resource. As India has rapid population growth therefore there is overconsumption of resources, such as uncontrolled

logging or overfishing and many valuable natural resources are rapidly being exhausted. India has huge watered fertile lands. In the sedimentary soil of the Northern Great Plains of the Sutlej-Ganga plains and Brahmaputra Valley wheat, rice, maize, sugarcane, jute, cotton, rapeseed, mustard, sesame, linseed, are grown in plentiful. India's land area includes regions with high rainfall to dry deserts, Coast line to Alpine regions.

India also has a variety of natural vegetation since the country has a varied relief and climate. These forests are narrowed to the plateaus and hilly mountainous areas. India has a great variety of wildlife. India has more marine and inland water resources.

2.2 Management of natural resources: Individual, community and government managed

Natural resource management (NRM) is the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations (stewardship). Natural resource management deals with managing the way in which people and natural landscapes interact. It brings together natural heritage management, land use planning, water management, bio-diversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry. The various approaches applied to natural resource management include:

- Top-down (command and control)
- Community-based natural resource management
- Adaptive management
- Precautionary approach
- Integrated natural resource management
- Ecosystem management

Role of Individual in conservation of Natural resources

Conservation of energy:

1. Switch off light, fan and other appliances when not in use.
2. Use solar heater for cooking.
3. Dry the cloth in the sun light instead of driers.

5. Grow trees near the house to get cool breeze instead of using AC and air cooler.

Conservation of water:

1. Use minimum water for all domestic purposes.
2. Check the water leaks in pipes and repair them properly.
3. Reuse the soapy water, after washing clothes for washing courtyard, carpets etc.
4. Use drip irrigation.
5. Rain water harvesting system should be installed in all the houses.

Conservation of soil:

1. Grow different type plants i.e. trees, herbs and shrubs.
2. In the irrigation process, using strong flow of water should be avoided.
3. Soil erosion can be prevented by sprinkling irrigation.

Conservation of forest:

1. Use non timber product.
2. Plant more trees.
3. Grassing must be controlled

Role of Community in conservation of Natural resources

Key elements of the approach include:

1. Multi-stakeholder collaboration that involves all participants, from communities, to government, to NGOs, and promotes coordination among them.

2. Conflict management mechanisms – support processes to manage natural resource conflicts among stakeholders.
3. Participatory action research – collaborative fact-finding and analysis generates a mutually agreed upon perspective for action.
4. Strong local organizations, such as forest-farmer groups and inter-village networks are built from the bottom-up.
5. Policy support and law enforcement are essential to curbing illegal encroachment leading to ecosystem degradation.

Role of Government in conservation of Natural resources

Natural resource management is an important thing that should be done by the community for survival. Consciously of many ways in the management of natural resources has resulted in environmental damage, coupled with government policies that give permission without good supervision to entrepreneurs or private individuals in natural resource management adds a long list of environmental damage. In the last three decades, governments tend to ignore the phenomenon of legal pluralism in the legal development policy, preparation of legal instruments, as well as the implementation of the law through political neglect of the fact legal pluralism. So the product of legislation, especially those that set natural resource management, normatively ignore and displace the rights of indigenous peoples and local over control, management, and utilization of natural resources. Moreover, with deprivation of the rights of indigenous peoples' customary rights and the implementation of development without taking into consideration the pattern of spatial planning, more and enlarge the conflict between the government and society.

2.3 Air, water and soil pollution: Causes, consequences and control

ENVIRONMENTAL POLLUTION

Pollution is derived from Latin word '**pollute**' which means 'to contaminate' any feature of environment. It is defined as *“the addition of any undesirable material to air, water and soil by a natural source or due to human activity which adversely affects the quality of environment is called **environmental pollution**”*.

Air Pollution

Air pollution may be defined as the presence of any solid, liquid or gaseous substance including noise and radioactive radiation in the atmosphere in such concentration that may be directly and indirectly injurious to humans or other living organisms, plants, property or interferes with the normal environmental processes. It is also defined as *“any undesirable change in the physical and chemical properties of the atmosphere which adversely affects the living systems is known as air pollution”*.

Classification of Air Pollutants

On the basis of origin of pollutants they can be classified as primary or secondary pollutants.

(i) Primary pollutants: Pollutants that are emitted directly from identifiable sources are produced by natural events can be in the form of particulate matter or gaseous form. These are called primary pollutants. These are emitted directly from the point source (identifiable source) *e.g.* carbon monoxide (CO), oxides of nitrogen (NO_x), oxides of sulphur (SO_x), hydrocarbons, radioactive substances etc.

(ii) Secondary pollutants: The pollutants that are produced in the atmosphere, when certain chemical reactions take place among the primary pollutants and with others in the atmosphere are called secondary air pollutants. These are formed by interaction of primary pollutant(s) with other primary pollutant(s) or with some

natural constituents of the atmosphere, e.g. ozone (O₃), peroxyacetyl nitrate (PAN), photochemical smog, etc.

Sources of Air Pollution

In general there are three basic categories of sources of pollution. They are:

(i) Point or Stationary Sources: It includes industries like petroleum refineries, fertilizer plants, paper factories, iron and steel industries etc. discharge various gaseous pollutants into the atmosphere from a specific point.

(ii) Line or Mobile Sources: It includes those sources which do not cause pollution at a specific point but are moving sources. These include automobiles as the major sources. Automobile exhausts release, in addition to particulates, various gases as pollutants into the air. These include carbon monoxide, nitrogen oxides, hydrocarbons, carbon dioxide.

(iii) Area Sources: It includes those sources of pollution which are prevalent in certain specific area e.g., natural sources like volcanic eruptions, pollen grains; mining activities etc.

Effects of Air Pollution on Biological Systems (Humans, Animals, Plants and Materials)

1. Effects on Humans:

(i) Small sized particulates have greater damaging effect on the humans because they can pass through the nose and enter the lungs easily whereas entry of big sized particles is checked in the nose and throat and can be easily removed from there.

(ii) The small particulates thus accumulated in the lungs have large surface area and act as excellent sites for adsorption of carcinogenic compounds such as polynuclear hydrocarbons, asbestos, etc. and cause diseases like lung cancer, bronchial asthma, chronic bronchitis, etc.

(iii) Different types of lung diseases are caused by different types of particulates e.g, asbestos causes *asbestosis*, dust containing free silica causes *silicosis*, coal

miners suffer from *black lung diseases* whereas textile workers suffer from *white lung diseases*, etc.

2. Effects on Animals:

The effects on animals of air pollution are similar to those observed on human beings.

3. Effects on Plants:

(i) Air pollutants affect plants by entering through stomata (leaf pores through which gases diffuse), destroy chlorophyll and affect photosynthesis. During the day time the stomata are wide open to facilitate photosynthesis.

(ii) Air pollutants during day time affect plants by entering the leaf through these stomata more than night. Pollutants also erode waxy coating of the leaves called cuticle.

(iii) Cuticle prevents excessive water loss and damage from diseases, pests, drought and frost. Damage to leaf structure causes *necrosis* (dead areas of leaf), *chlorosis* (loss or reduction of chlorophyll causing yellowing of leaf) or *epinasty* (downward curling of leaf), and *abscission* (dropping of leaves).

(iv) Particulates deposited on leaves can form encrustations and plug the stomata and also reduce the availability of sunlight. The damage can result in death of the plant.

(v) SO₂ causes bleaching of leaves, chlorosis, injury and necrosis of leaves.

(vi) NO₂ results in increased abscission and suppressed growth.

(vii) O₃ causes flecks on leaf surface, premature aging, necrosis and bleaching. Peroxyacetyl nitrate (PAN) causes silvering of lower surface of leaf, damage to young and more sensitive leaves and suppressed growth.

4. Effects on Materials:

Particulates damage a large number of materials e.g, soot, dust, fumes, mists, etc. damage paints, clothes, buildings, soil, sculptures, monuments etc. They also accelerate corrosion of metals.

Remedial Measures for Air Pollution (Control):

Air pollution can be minimized by the following methods:

1. Intensive plantation around the settlements reduces the amounts of particulates like dust etc in the air. The trees having simple leaves have been proven much effective. Social forestry and community forestry programmes prove to be effective in controlling air pollution.
2. Installation of industrial units away from human habitations so as to minimize immediate effects of these gases. Besides these, gases get diluted before reaching the people.
3. Shifting to public transport facilities rather than personal conveniences to minimize the release of automobile exhaust.
4. Using much efficient machinery in industry and automobiles to ensure proper and complete combustion of fuels.
5. Using absorbers for unwanted chemicals at the source and along the paths of diffusion of pollutants.
6. Using low sulphur coal in industries.
7. Removing sulphur from coal (by washing or with the help of bacteria).
8. Removing NO_x during the combustion process and controlling the flow of air and fuel in industrial boilers.
6. Enactment of environment laws.
7. Creating public awareness through debates, discussion, seminars, symposia, etc about the hazards of air pollution.
8. Use of control equipments.
9. Using non-conventional sources of energy.

Water Pollution

Introduction

Water is inevitable for life. Without water life is not possible. From the point of view of priorities, water comes next to the air only. This is not only needed for human beings, but for animals and fowls as well. Even trees and plants cannot survive without water. A man may live for a few days without food but he cannot live for more than three days without water. Other than drinking, water is also needed for keeping the body, house, clothes and other things clean. It is needed for cleaning the houses, the roads and other places of residence and working. It is also necessary for agriculture, industry, navigation, construction work and plant life. Fresh and pure water is essential for health. Contamination of water will directly affect the health and economy of man.

Definition

Any undesirable substance beyond the threshold level in the hydrosphere which adversely affects the human health is known as water pollution. In other words, any undesirable change in the physical, chemical or biological characteristics of water making it unsuitable for designated use in its natural state. Water pollution is one of the most serious environmental problems.

Sources of Water Pollution

Water pollution is caused by both natural process of decay and decomposition of animals and plants and the anthropogenic activities such as industrial and domestic effluents, use of pesticides, fertilizers etc. The sources of water pollution can be categorized as:

1. Point Sources: In which almost definite, constant and fixed composition of effluents are discharged directly into a water body like industrial discharge and sewage etc.

2. Non-Point or Diffused Sources: In which the effluents are added at different positions with varied composition and volume. These are generally dispersed and diverse in nature e.g. agricultural and domestic run off, acid rain, rainwater sweeping roads and fields, etc.

Effect of Water Pollution:

1. **Eutrophication** The term Eutrophication has been derived from the Greek word 'eutrophos' meaning (Nutrient Rich or Well-nourished"). Eutrophication is defined as the process by which a body of water becomes enriched in dissolved nutrients (such as phosphates) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen e.g, Chilka Lake in Orissa Human activities are mainly responsible for the eutrophication of a growing number of lakes and water bodies in the country.

2. **Algal Bloom:** The sudden and explosive growth of phytoplankton and algae impart green colour to the water is known as water bloom, or "**algal blooms**".

3. **Biomagnification**, also known as **Ecological amplification** or **biological magnification**, is the increase in concentration of a substance, such as the pesticide DDT, that occurs in a food chain as a consequence of: Persistence (can't be broken down by environmental processes), Food chain energetics, Low (or non-existent) rate of internal degradation/excretion of the substance (often due to water-insolubility).

Biological magnification often refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers or lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the chain (**Fig. 9**).

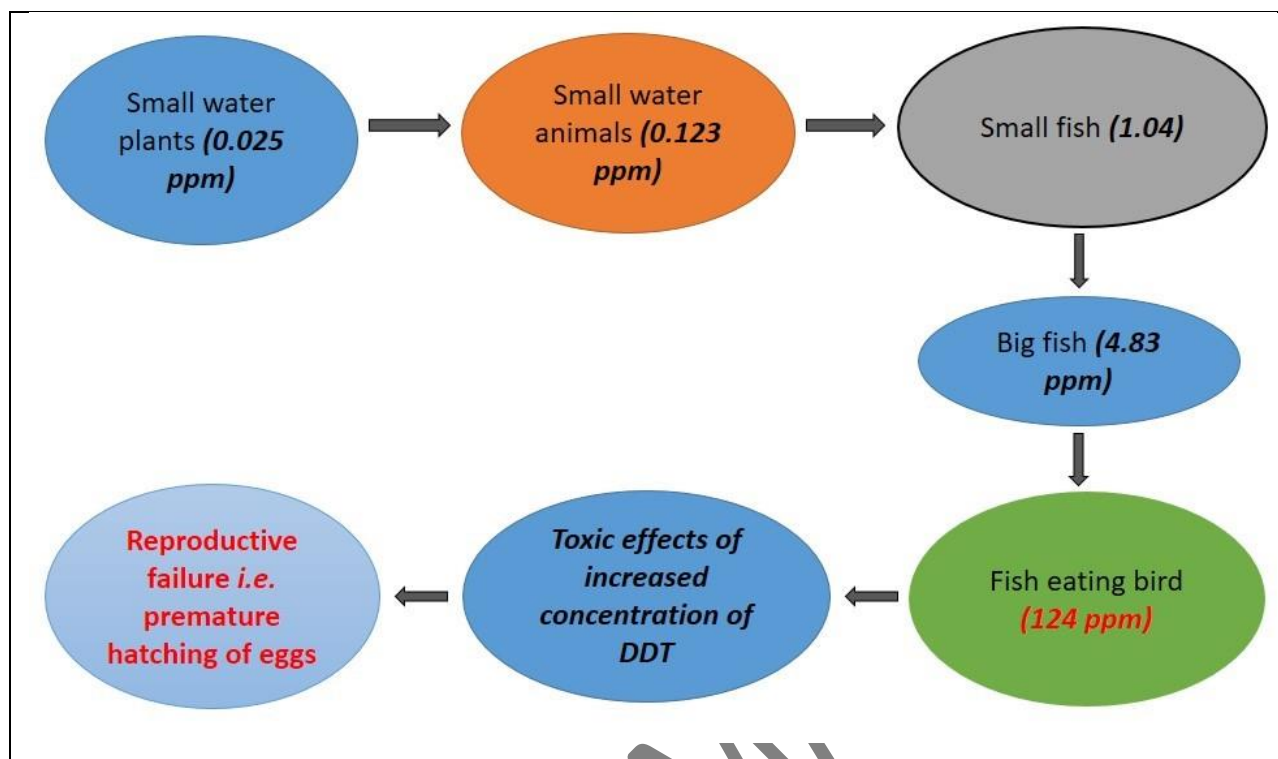


Fig. 9: The Process of Biomagnification

4. Bioaccumulation/ bioconcentration.: Accumulation of non-biodegradable substances in the body known as bioaccumulation.

5. Nitrate Pollution: Nitrate ions present in the water are harmful to human health. From nitrogen fertilizers, nitrate ions seep into water bodies from where these may bioaccumulate in the bodies of the consumers. In the stomach nitrate is reduced to nitrite and is responsible for **blue baby syndrome** and stomach cancer. Young children less than 1 year of age when ingest excessive nitrate, nitrite is formed in their stomach by microbes as the stomach is not acidic to the extent to inhibit the microbes. Nitrite reacts with haemoglobin which is converted into non-functional oxidized form. Due to diarrhoea and vomiting child becomes slate blue, giving the baby blue baby syndrome or **methaemoglobinaemia**.

6. Heavy Metals: Pollution by heavy metal like cadmium had caused the disease called **Itai-itai** in the people of Japan. The disease was caused by cadmium

contaminated rice. The rice fields were irrigated with effluents of zinc smelters and drainage water from mines. In this disease bones, liver, kidney, lungs, pancreas and thyroid are affected.

8. Effects of Health Aspects on Water Quality: Consumption of polluted water is a major cause of ill health in India. Polluted water causes some of the deadly diseases like cholera, dysentery, diarrhoea, tuberculosis, jaundice, etc. About 80 per cent of stomach diseases in India are caused by polluted water.

Remedial Measures for Water Pollution (Control)

It is easy to reduce water pollution from point sources by legislation. However, due to absence of defined strategies it becomes difficult to prevent water pollution from non-point sources. The following points may help in reducing water pollution from non-point sources.

- (i) Judicious use of agrochemicals like pesticides and fertilizers which will reduce their surface run-off and leaching. Use of these on sloped lands should be avoided.
- (ii) Use of nitrogen fixing plants to supplement the use of fertilizers.
- (iii) Adopting integrated pest management to reduce greater reliance on pesticides.
- (iv) Prevent run-off of manure. Divert such run-off to basin for settlement. The nutrient rich water can be used as fertilizer in the fields.
- (v) Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rain water.
- (vi) Planting trees would reduce pollution by sediments and will also prevent soil erosion.

For controlling water pollution from point sources, treatment of waste waters is essential before being discharged. Parameters which are considered for reduction in such water are:

- (i) Total solids, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates and phosphates, oil and grease, toxic metals etc.

(ii) Waste waters should be properly treated by primary and secondary treatments to reduce the BOD, COD levels upto the permissible levels for discharge.

Soil Pollution

Introduction

Soil is an integrated and essential part of terrestrial ecosystems. All soils are made of the same major components mineral particles of various sizes, chemical structures and organic matter in various stages of decomposition. The particle size and composition of soil in an area depends on the source material; the rock types available for weathering, the presence of glacial tills left by melting glaciers and wind deposited particles.

The scientific study of soil deals with the origin, formation and geographic distribution of the soil. It is called as **pedology** and those who study soil science are called as **pedologists**.

Definition

The term soil is derived from the Latin word **solum** which means floor. Addition of substances which adversely affect the quality of soil or its fertility is known as soil pollution (also called soil contamination). Any substance that reduces the productivity of soil is known as soil pollutant. If the pollutants are passed over soil directly, we call it as **direct soil pollution** e.g, pollution caused by industrial effluents and fertilizers. If the pollutants reach the soil from other sources like air and water, we call it as **indirect soil pollution**, e.g. soil pollution caused due to acid rain.

Types of Soil Pollution:

The two types of soil pollution are positive pollution and negative pollution. They are explained below:

1. Positive Soil Pollution: When productivity of soil gets reduced due to the addition of industrial waste, insecticides, radioactive substances, fertilizers, etc

pollution is positive. e.g, salination of soil is a positive pollution. Salination of soil means increase in the concentration of soluble salts in the soil. Salination reduces soil productivity and excess salt accumulation may be seen as a white crust on soil surface.

2. Negative Soil Pollution: When productivity of soil is reduced or lost due to reduction of its mineral contents or by destruction of its top layer, then the pollution is termed as negative soil pollution. Desertification and soil erosion are examples of negative pollution.

Sources of Soil Pollution:

There are several causes of soil pollution, these include: (a) Anthropogenic causes (human generated causes) and (b) Natural causes.

Anthropogenic causes:

(i) Domestic/Municipal wastes: Municipal wastes (like domestic waste- kitchen wastes, sewer waste, polyethylene bags, papers, plastics, metallic canes and containers etc.; hospital wastes - syringe, used bottles (glass and plastics), bandage, cotton, etc. and domestic industries - paints, varnish, dye, yarn waste etc) are generally dumped into the soil as landfills which cause soil pollution.

(ii) Agriculture: It is a big source of soil pollution. Through the over-exploitation of the soil, it often loses its fertility. This leads to lower crop yields in the future and thus may lead to food shortages.

(iii) Excessive use of fertilizers and pesticides: Another related problem is the excessive use of pesticides and fertilizer. In our industrial farming culture, farmers often use large amounts of chemicals in order to increase their yields. However, this has serious adverse effects on the soil quality. Part of the fertilizer and the pesticides are not absorbed by the plants and thus contaminate the soil. Moreover, since the structure and composition of the soil is changed through the

contamination with chemicals, soil pollution increases the likelihood of the erosion by air or water.

(iv) Deforestation: It can also lead to soil pollution. Trees, with their roots, ensure the stability of the soil. If trees or whole forests are cleared, the soil is now exposed to wind and water and thus the likelihood for soil erosion increases dramatically.

(v) Mining: In the mining process, raw materials are often processed and crushed to make them useful for further usage. However, for these processes, heavy metals and other chemicals are often used which can contaminate the soil if they are not handled with great care.

(vi) Construction: This processes play an important role in the context of soil pollution since in construction, many chemicals and other harmful substances are used which can contaminate the ground. Moreover, construction sites often also emit large amounts of toxic dust, which settles in the nearby areas and thus contaminates the air and also the soil.

(vii) Landfills: It can be a great cause for soil contamination if they are not set up properly. If landfills are used, we have to make sure that the materials disposed in these landfills do not touch the soil. If they get in contact with the ground, the soil can be contaminated by heavy metals and other harmful substances.

(viii) Chemical waste: If chemical waste is not disposed in an appropriate manner, it can have severe adverse effects on the soil. Many of these chemicals, especially these which are used in industrial processes, are highly toxic and can contaminate the soil for a quite long period of time.

Natural causes:

(i) Health effects: Soil pollution can have severe public health effects. If the soil is contaminated, the plants cultivated on this soil are also contaminated. Through the food chain, this also has adverse effects on us humans.

(ii) Effect on microorganisms: Microorganisms are harmed by soil pollution since they are usually quite sensitive to a change in their natural environmental conditions. Through the contamination of soil with heavy metals and other harmful substances, these microorganisms are often not able to adjust to the new circumstances appropriately and thus will die off.

(iii) Effects on animals: All kinds of animals are affected by soil pollution. Many animals eat crops or plants in order to meet their energy demand.

(iv) Effects on soil structure: In addition, the structure of the soil itself can change due to a contamination with certain chemicals. This can lead to an increasing probability for erosion and may also harm the fertility.

Remedial Measures for Soil Pollution

Since the problem of land degradation is very complex, it is important to approach the issue in a systematic and logical manner. The following are some steps that can be taken for reducing the gravity of the problem:

1. Proper records of land productivity status should be prepared with the help of soil scientists along with the latest technologies like remote sensing.
2. In areas of high water requirement like cropped areas, effective soil and water conservation techniques should be adopted with the guidance of engineers.
3. Industrial activities in the nearby areas, which are hazardous to the environment, should be regulated through laws.
4. Sustainable and effective land use system should be followed.
5. Implementation of agro-forest ecosystem, wherever water erosion is a serious threat.
6. Adoption of integrated water-shed management system and integrated balanced nutrient management system.
7. Auto-regenerating the soil fertility by adding organic matter through micro-organism and incorporation of crop residues should be facilitated.

8. By the use of biofertilizers and manures (which are biological in origin), use of chemical fertilizers can be reduced.
9. By biological control of pests, pesticides can be reduced.
10. Treatment of industrial and municipal sewage can reduce soil pollution, prior to its discharge.
11. Enforcement of environmental regulatory laws.
12. Educating the masses through different media.

AADIL SIR'S MATERIAL

2.4 Solid waste management: Collection, segregation, transportation and disposal; 3R's

Solid waste management

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc). Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

2.4.1 Classification of wastes

Various bases can be used to classify wastes like their origin, hazard or composition. However, conveniently these may be classified into following categories as

- **Garbage:** — These include vegetable residues, meat, fruit residues which decompose rapidly under warm weather conditions.
- **Rubbish:**— These include crockery, metals, glass, rubber, leather, plastic wastes which do not decompose rapidly.
- **Agricultural wastes:**— These include crop residues from agricultural fields, farm manure e.g., Rice straw, jute, cotton, sugarcane wastes etc.
- **Industrial wastes:**— These are produced as a result of industrial operations e.g. sewage, paints, toxic metals flyash etc.

- **Hazardous waste:**– Those wastes which have an adverse effect on human, plant and animal health because of their ignitibility, corrosivity, reactivity, toxicity etc e.g. radioactive or nuclear wastes, explosives heavy metals etc.
- **Junk :**– Used things like machines, automobiles, their parts etc.
- **Construction or demolition wastes:**– The wastes which are generated as a result of construction, repair or demolition of industrial, commercial or domestic buildings such as bricks stones, dust, plaster etc. are known as construction & demolition wastes.

Key components of solid waste management

Solid waste management can be divided into following key components in **Fig 10:**

a) Generation

Generation of solid waste is the stage at which material become valueless to the owner and since they have no use for them and require them no longer, they wish to get rid of them. Items which may be valueless to one individual may not necessarily be valueless to another. For example, waste items such as tins and cans may be highly sought after by young children.

b) Storage

Storage is a system for keeping materials after they have been discarded and prior to collection and final disposal. Where on-site disposal systems are implemented, such as where people discard items directly into family pits, storage may not be necessary. In emergency situations, especially in the early stages, it is likely that the affected population will discard domestic waste in poorly defined heaps close to dwelling areas. If this is the case, improved disposal or storage facilities should be provided fairly quickly and these should be located where people are able to use them easily. Improved storage facilities include:

- Small containers: household containers, plastic bins, etc.
- Large containers: communal bins, oil drums, etc.

- Shallow pits
- Communal depots: walled or fenced-in areas

c) Collection

Waste collection is the collection of solid waste from point of production (residential, industrial commercial, institutional) to the point of treatment or disposal. Municipal solid waste is collected in several ways:

House-to-House: Waste collectors visit each individual house to collect garbage. The user generally pays a fee for this service.

Community Bins: Users bring their garbage to community bins that are placed at fixed points in a neighborhood or locality. MSW is picked up by the municipality, or its designate, according to a set schedule.

Curbside Pick-Up: Users leave their garbage directly outside their homes according to a garbage pick-up schedule set with the local authorities (secondary house-to- house collectors not typical).

d) Transportation

After collection, waste is transported to suitable places (disposal sites) for further processing. The waste needs to be transported to the disposal sites in covered trucks in order to prevent environmental contamination. There are various modes of transport which may be adopted and the chosen method depends upon local availability and the volume of waste to be transported.

e) Separation or Segregation

The wastes from different sources are heterogeneous in nature and hence need to be segregated either at the source or after collection. Usually wastes are segregated manually into organic and inorganic category. Organic waste like leftover food, fruits, vegetables, biomass, paper, disintegrate naturally under the influence of sun, rain, living organisms etc. while as inorganic wastes like glass, plastic etc. need to be placed in separate containers before disposal. Generally separation helps in

recovery and reuse of materials out of the solid waste or safe and compatible disposal of disposable materials.

f) Disposal

The final stage of solid waste management is safe disposal where associated risks are minimized. There are four main methods for the disposal of solid waste:

Open dumping

Composting

Burning or incineration

Recycling (resource recovery)

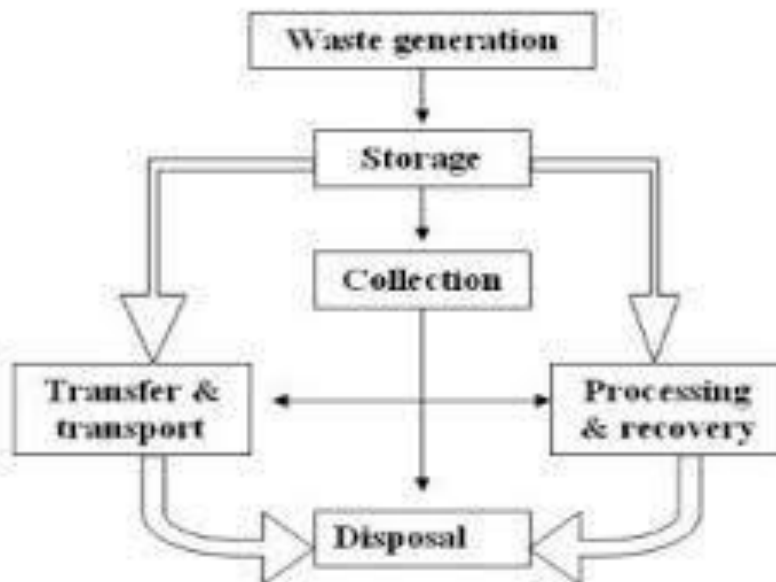


Fig.10: key components of solid waste management

Management of Solid Waste: For waste management we stress on 3 R's principle: Reduce, Reuse and Recycle in **Fig.11**.

- Reduce the amount and toxicity of garbage and trash that you discard.
- Reuse containers and try to repair things that are broken.
- Recycle products wherever possible, which includes buying recycled products *i.e.* recycled paper books, paper bags etc. These are processes that

involve integrated waste management practices (IWM). They can reduce the wastes generated by approximately 50 %.

1. Reduce (Waste prevention): Waste prevention, or “source reduction,” means consuming and discarding less, is a successful method of reducing waste generation. Backyard composting, double sided copying of papers, purchasing durable, long- lasting environmentally friendly goods; products and packaging that are free of toxics, redesigning products to use less raw material production and transport packaging reduction by industries are the normal practices used and have yielded substantial environmental benefits. Source reduction prevents emissions of many greenhouse gases, reduces pollutants the need saves energy, conserves resources, and reduces wastes for new landfills and combustors. It reduces the generation of waste and is generally preferred method of waste management that goes a long way toward saving the environment.

2. Re-use: Re-use is the process, which involves reusing items by repairing them, donating them to charity and community groups, or selling them. Reusing products is an alternative to recycling because the item does not need to be reprocessed for its use again. Using durable glassware, steel using cloth napkins or towels, reusing bottles, reusing boxes, purchasing refillable pens and pencils are suggested.

3. Recycling: The process of recycling, including composting, has diverted several million tons of material away from disposal. Recycled materials include batteries, recycled at a rate of 93%, paper and paperboard at 48%, and yard trimmings at 56%. These materials and others may be recycled through drop off centers, buy-back programs, and deposit systems. Recycling prevents the emission of many greenhouse gases that affect global climate, water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children’s future, and reduces the need for new landfills and combustors.



Fig.11: 3 R's principle: Reduce, Reuse and Recycle

For **discarding wastes** the following methods can be adopted:

(i) **Sanitary landfill:** 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.

(ii) **Composting:** Due to shortage of space for landfill in bigger cities, the biodegradable yard waste (kept separate from the municipal waste) is allowed to degrade or decompose in an oxygen rich medium. A good quality nutrient rich and environmental friendly manure is formed which improves the soil conditions and fertility.

(iii) **Incineration:** Incinerators are burning plants capable of burning a large amount of materials at high temperature generally more than 900°C.

Effects of Solid Wastes: 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. This type of dumping allows biodegradable materials to decompose under uncontrolled and

unhygienic conditions. This produces foul smell and breeds various types of insects and infectious organisms besides spoiling the aesthetics of the site.

Industrial solid wastes are sources of toxic metals and hazardous wastes, which may spread on land and can cause changes in physico-chemical 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.

AADIL SIR'S MATERIAL

2.5 Climate change: Causes and consequences

Definition

Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period (at least 30 years) are called climate.

The phrase 'climate change' represents a change in the long-term weather patterns. Climate change is not a change of weather in a particular day; it is the cumulative change of long term weather pattern i.e. changes in climate.

In other words, Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Factors responsible for climate change

Significant human-led factors responsible for climate change are:

- Exponential growth in human population.
- Massive and unplanned urbanization and industrialization over the last century.
- Burning of fossil fuels such as coal, petroleum, and natural gas at huge scale to meet the growing energy needs of the bulging world population.
- Change in lifestyle and massive increase in the number of machinery, gadgets, etc.

Impact of Climate Change on Human Environment

The following are some consequences of climate change:

- Change in hydrological cycle and water supply.
- Increase in tropical and temperate cyclones, cloud cover, tornadoes and storms.

- Changes in pressure belts and atmospheric circulation.
- Warming of ocean water may endanger the corals worldwide.
- Expansion of deserts and more desertification within deserts.
- Effect on food supply and international trade of grains.

AADIL SIR'S MATERIAL

Eminent People in the Environment Field

There are several internationally known environmental thinkers. Among those who have made landmarks, the names that are usually mentioned are Charles Darwin, Ralph Emerson, John Muir, Rachel Carson and EO Wilson. Each of these thinkers looked at the environment from a completely different perspective.

Charles Darwin wrote the '*Origin of Species*', which brought to light the close relationship between habitats and species. It brought about a new thinking of man's relationship with other species that was based on evolution. Alfred Wallace came to the same conclusions during his work.

Ralph Emerson spoke of the dangers of commerce to our environment way back in the 1840s.

John Muir is remembered as having saved the great ancient sequoia trees in California's forests. In the 1890s he formed the Sierra club, which is a major conservation NGO in the USA.

EO Wilson is an entomologist who envisioned that biological diversity was a key to human survival on earth. He wrote '*Diversity of Life*' in 1993, which was awarded a prize for the best book published on environmental issues. His writings brought home to the world the risks to mankind due to man-made disturbances in natural ecosystems that are leading to the rapid extinction of species at the global level. There have been a number of individuals who have been instrumental in shaping the environmental history in our country. Some of the well-known names in the last century include environmentalists, scientists, administrators, legal experts, educationists and journalists.

Salim Ali's name is synonymous with ornithology in India and with the Bombay Natural History Society (BNHS). He also wrote several great books including the famous 'Book of Indian Birds'. His autobiography, '*Fall of a Sparrow*' should be read by every nature enthusiast. He was our country's leading conservation scientist and influenced environmental policies in our country for over 50 years.

Indira Gandhi as PM has played a highly significant role in the preservation of India's wildlife. It was during her period as PM, that the network of PAs grew from 65 to 298! The Wildlife Protection Act was formulated during the period when she was PM and the Indian Board for Wildlife was extremely active as she personally chaired all its meetings. India gained a name for itself by being a major player in CITES and other International Environmental Treaties and

Accords during her tenure. BNHS frequently used her good will to get conservation action initiated by the Government.

M C Mehta is undoubtedly India's most famous environmental lawyer. Since 1984, he has filed several Public Interest Litigations for supporting the cause of environmental conservation. His most famous and long drawn battles supported by the Supreme Court include protecting the Taj Mahal, cleaning up the Ganges River, banning intensive shrimp farming on the coast, initiating Government to implement environmental education in schools and colleges, and a variety of other conservation issues.

Anil Agarwal was a journalist who wrote the first report on the 'State of India's Environment' in 1982. He founded the Center for Science and Environment which is an active NGO that supports various environmental issues.

Medha Patkar is known as one of India's champions who have supported the cause of downtrodden tribal people whose environment is being affected by the dams on the Narmada River.

Sunderlal Bahugna's Chipko Movement has become an internationally well-known example of a highly successful conservation action program through the efforts of local people for guarding their forest resources. His fight to prevent the construction of the Tehri Dam in a fragile earthquake prone setting is a battle that he continues to wage. The Garhwal Hills will always remember his dedication to the cause for which he has walked over 20 thousand kilometers.

Environment Calendar	
➤ World Wetland Day	February 2
➤ World Forest Day	March 21
➤ World Water Day	March 22
➤ World Meteorological Day	March 23
➤ World Earth Day	April 22
➤ International Biodiversity Day	May 22
➤ Anti-tobacco Day	May 3
➤ World Environment Day	June 5
➤ World Ocean Day	June 8
➤ World Population Day	July 11
➤ World Ozone Day	Sept. 16
➤ World Habitat Day	Oct. 3
➤ Wildlife Week	Oct. 1–7
➤ International Day for Natural Disaster Reduction	Oct. 13
➤ World Conservation Day	Oct. 24
➤ International Day for Biological Diversity	Dec. 29

About the Author

Dr. Aadil Gulzar Khan (Ph.D; M.Phil; M.Sc; NET; B.ed; PGDDM; COPA) presently is working as Contractual Assistant Professor, Department of Environmental Science, GDC Kokernag, Kashmir. He has published **21** research papers in journals of repute, **10** book chapters and **3** articles. He has completed **4** training programs and has also worked in **3** projects as JRF position. He has attended more than **30** National and International conferences, seminars, workshops and webinars. He has also five years teaching experience at University and College levels and also working IGNOU Counselor in M.Sc Environmental Science course. He has received the **BEST YOUNG RESEARCHER NATIONAL AWARD** for the outstanding excellence and remarkable achievements in the field of TEACHING, RESEARCH and PUBLICATIONS as well as received the **Best Oral presentation** award at “International Conference on Environmental and Ecological Sustainability: Engaging the Stakeholders” under IGNOU University. His areas of interested are Biodiversity and Conservation Biology, Environmental Laws, Alpine-Treeline Ecotone Vegetation, Soil and Water Quality Analysis. He is a member of Environmental Policy Group, Srinagar (J&K) and Ecoparyavaran Organization (Chandigarh).



“Start by doing what is necessary, then what is possible and suddenly you are doing the impossible”. (Dr. Aadil)

Some Popular Quotes

- *The first aim of education should not be able to prepare young people for careers, but to enable them to develop a respect for life.*
- Education is the means of changing knowledge, skills, attitudes and behaviors, and ultimately improving the very quality of life on earth.
- *Three things are necessary in any field to achieve goal: consistency, dedication and planning.*
- That kind of life is most happy which affords us the most opportunities of gaining our own esteem.
- *Goodwill is the mightiest force in the universe.*
- Peace on Earth depends on our ability to secure our living environment.

(Dr. Aadi)

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