DETAILED LECTURE NOTES

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1.1 Introduction

The term environment is considered as a composite term for the conditions in which organisms live. It consists of air, water, food and sunlight which are the basic needs of all living beings and plant life to carry on their life functions. The environment also includes other non-living things like temperature, wind, electricity etc. In other words, environment made up of both biotic and abiotic components. The abiotic or non living environment includes medium and the climate, which considerably affect the activities of the organisms. The biotic environment refers to the relationship existing among different organisms. Environment creates favourable conditions for the existence and development of living organisms. In context of human beings, environment can be defined by following ways:

1. Environment is the sum of all social, economical, biological, physical or chemical factors which constitute the surroundings of a man, who is both creator and moulder of his environment.
2. It refers to the sum total of conditions which surround man at a given point in space and time.
3. Environment is the representative of physical components of the earth where man is the important factor influencing his environment.

1.5 Environmental Pollution

Any kind of change, which causes adverse effect on the physical, chemical or biological characteristics of environmental components such as air, water, land or soil is called environmental pollution. It may ultimately affect the human beings, animals, plant life or materials.

(b) **Secondary Pollutants:** Those substances which are derived from the chemical reactions of primary pollutants or by chemical reactions of primary pollutant with some constituent of the atmosphere. Examples are, nitrogendioxide, ozone, aldehydes, sulphur trioxide, peroxyacetyl nitrate (PAN) etc.

3. *On the basis of ecosystem,* pollutants may be classified as follows:

(a) **Bio-degradable Pollutants:** Bio-degradable pollutants are those which can be decomposed easily in their natural environment. Heat or thermal pollution and domestic sewage are considered in this group as these can be decomposed by natural process or by engineered systems such as municipal sewage treatment plant etc.

(b) **Non-biodegradable Pollutants:** Those pollutants which either do not degrade or degrade very slowly in the natural environment are called non-biodegradable pollutants. It includes mercury and lead salts, phenolic compounds, DDT and aluminium cans etc. Such pollutants not only accumulate, but are often biologically magnified as they move in biochemical cycles and in food chains.

Types of Pollution

Different types of pollution and their sources. There are several kinds of pollution now a days. Main among them are as follows.

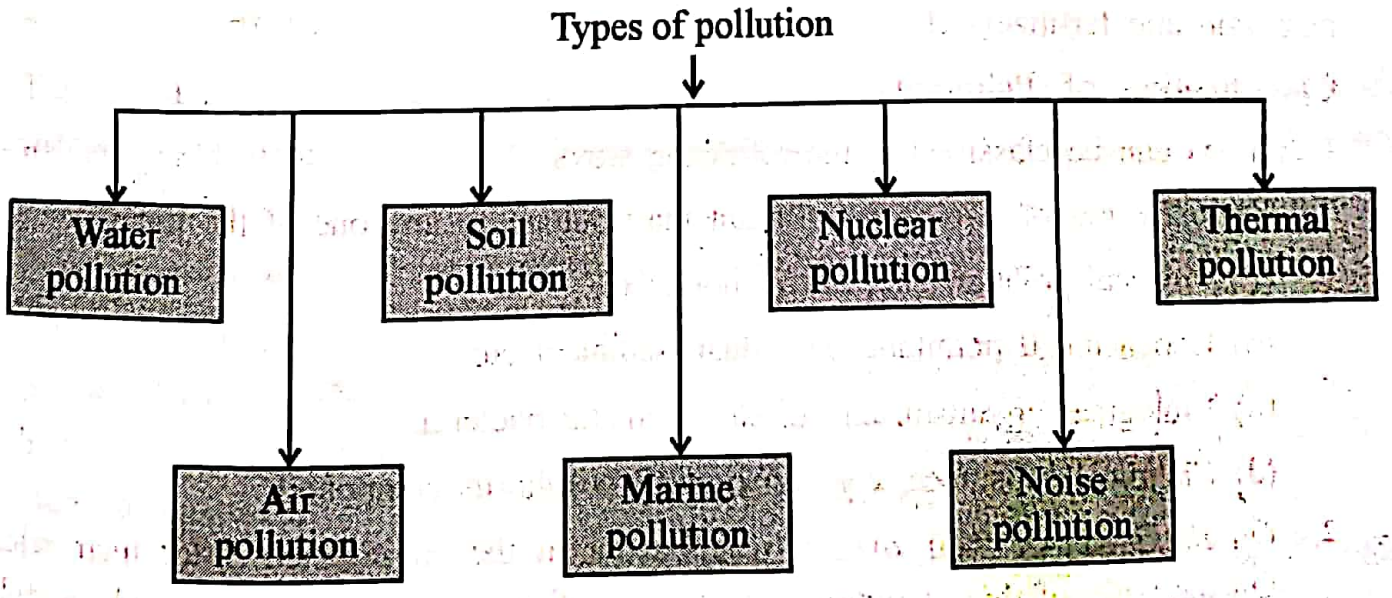

Figure 1.4 Types of pollution

1.8 Various Acts and Regulations for Environmental Protection

Environmental Legislation in India

Makers of Indian constitution showed their concern for environmental protection in as early as 1950 by making provisions in chapters of Fundamental Rights and Directive Principles. In this regard, Article 47 of our constitution includes a statement that "State shall regard the raising of the level of nutrition and standard of living of its people and improvement of public health as among its primary duties".

In 1976, the constitution was amended and Article 48 (A) was added. As per article 48 (A): "The state shall endeavour to protect and improve the environment and to safeguard the forest and wildlife of the country."

In order to make Indian citizens more responsible, Government of India added fundamental duties to be observed by every citizen of the country in Article 51 A(g). As per the Article, the fundamental duty of every citizen is: "To protect and improve the national environment including forest, lakes, rivers and wildlife and to have compassion for leaving creatures."

The Department of Environment was established in India in 1980 to ensure a healthy environment for the country. Later it became the Ministry of Environment and Forests in 1985.

Environmental lawyer M.C. Mehta field a petition in the Supreme Court of India in 1985 against all the industries and all the municipal towns in the Ganga river basin looking to the effluent which were so toxic that a matchstick could start a fire. This case became a landmark event in Indian Public Interest Litigation (PIL) and judicial activism. Justice Kuldeep Singh issued directions every week in an attempt to clean up the Mess in the Ganga river. With the help of Mr. Mehta, the court identified the polluters and each

Environmental Legislations for Air

1948-The Factories Act, 1948 and Amendment in 1987: It was the first legislated to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

1981-The Air (Prevention and Control or Pollution) Act, 1981: It provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the CPCB.

1982-The Air (Prevention and Control of Pollution) Rules, 1982: It defines the procedures of the meetings of the Boards and the powers entrusted to them.

1981-The Atomic Energy Act, 1981 It deals with the regulation of radioactive waste.

1987-The Air (Prevention and Control of Pollution) Amendment Act, 1987: It empowers the Central and State Pollution Control Boards to meet in grave emergencies of air pollution.

1988-The Motor Vehicles Act, 1988: It envisaged the reduction and control of the Traffic Pollution.

The details of some of the significant acts pertaining to environmental protection in India are as follows:

General Environmental Legislations

1986-The Environment (Protection) Act, 1986: It authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources and prohibit or restrict the setting and or operation of any industrial facility on environmental grounds.

1986-The Environment (Protection) Rules, 1986: It lays down procedures for setting standards of emission or discharge of environmental pollutants.

1989-The Hazardous Waste (Management and Handling) Rules, 1989: The objective of this act is to control the generation, collection, treatment, import, storage and handling of hazardous waste.

1989-The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989: It defines the terms used in this context and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and isolated storage facilities.

1989-The Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms/Genetically Engineered Microorganisms or Cess Rules, 1989: It

introduced with a view to protect the environment, nature and health in connection with the application of gene technology and microorganisms.

1991-The Public Liability Insurance Act 1991: It was drawn up to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident while handling any hazardous substance.

1995 – The National Environment Tribunal Act, 1995: It has been created to hear appeals with respect to restrictions of areas in which classes of industries etc. are prescribed subject or certain safeguards under EPA.

1997-The National Environment Appellate Authority Act, 1997: It has been created to hear appeals with respect to restrictions of areas in which classes of industries etc. are carried out or prescribed subject to certain safeguards under the EPA.

1998-The Biomedical waste (Management and Handling) Rules, 1998: It is a legal binding on the health care institutions to streamline the process of proper handling of hospital waste such as segregation, disposal, collection and treatment.

1999-The Environment (Siting for Industrial Projects) Rules, 1999: It lays down detailed provisions relating to areas to be avoided for sitting of industries, precautionary measures to be taken for site selecting as also the aspects of environmental protection which should have been incorporated during the implementation of the industrial development projects.

2000-The Municipal Solid Wastes (Management and Handling) Rules, 2000: It applies to every municipal authority responsible for the collection, segregation, storage, transportation, processing and disposal of municipal solid wastes.

2001-The Batteries (Management and Handling) Rules, 2001: These rules shall apply to every manufacturer, importer, re-conditioner, assembler, dealer, auctioneer, consumer and bulk consumer involved in the manufacture, processing, sale, purchase and use of batteries or components, so as to regulate and ensure the environmentally safe disposal of used batteries.

2002-The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002: It lays down such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems during night hours (between 10.00 pm. to 12.00 a.m. midnight) on or during any cultural or religious festive occasion.

2002-The Biological Diversity Act, 2002: This is an act to provide for the conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources and knowledge associated with it.

1927-The Indian Forest Act, 1927 (and Amendment, 1984): It is one of the many surviving colonial statutes. It was enacted to 'consolidate the law related to forest, the transit of forest produce and the duty leviable on timber and other forest produce.

1972-The Wildlife Protection Act, Rules 1972, 1973 (Amendment 1991): This provides for the protection of birds and animals and for all matters that are connected to it whether it be their habitat or the water hole or the forests that sustain them.

1980-The Forest (Conservation) Act and Rules, 1981: It Provides for the protection of and the conservation of the forests.

1.9 The Environment Protection Act, 1986

This act was enacted to provide for the protection and improvement of environment and matters related to it. It provides general powers to the central government to take all necessary measures for the purpose of the following:

1. Protecting and improving the quality of environment and
2. Prevention, control and reduction of environmental pollution. Besides other powers, the central government shall have powers for:
   (a) Planning and execution of a nation-wide programme for the prevention, control and reduction of environmental pollution.
   (b) Laying down standards for the quality of environment in its various aspects.
   (c) Laying down standard for emission and discharge of environmental pollutants from various sources.
   (d) Laying down procedures for handling hazardous substances.
   (e) Laying down procedures and safeguards for prevention of accidents which may cause pollution.
   (f) Examination of materials, which are responsible for pollution.
   (g) Carrying out and sponsoring investigations and research relating to problems of environmental pollution.

1.10 The Air (Prevention and Control of Pollution) Act, 1981

The Act was promulgated in 1981. It is therefore known as the Air (Prevention and Control of Pollution) Act, 1981. The act was amended in 1987.

This act was promulgated for prevention, control and abatement of air pollution by creating Central and State Boards for control of air pollution.

Objectives

This act has serve the following objectives:

1. Prevention, control and abatement of air pollution.
2. Maintaining the quality of air.
3. Establishment of Boards for the prevention and control of air pollution.

Definition of Pollution Under this Act

'Air pollution' means presence of any air pollutant in the atmosphere.

⇒ **'Air pollutant'** means any solid, liquid or gaseous substance pres atmosphere in such concentration as may be or tend to be injurious to h or other living creatures or environment.

⇒ **'Control equipment'** means any equipment, device, apparatus or system the quality and manner of emission of any air pollutant and includes any for securing the efficient operation of any industrial plant.

1.11 The Water (Prevention and Control of Pollution) Act, 1974

It was promulgated in 1974. Therefore, it is known as the Water (Prevention & Control of Pollution) Act, 1974

It was amended in 1988. An important amendment was to rename the Central/State Boards for Prevention and Control of Water Pollution as Central/State Pollution Control Boards.

Objectives: This Act has the following objectives:

1. Prevention and control of water pollution.
2. Maintaining or restoring the wholesomeness of water.
3. Establishment of Boards for the prevention and control of water pollution.

Definition of Pollution under the Act

Pollution is defined as the contamination of water or the alteration of physical, chemical or biological properties of water or the discharge of any sewage or trade effluent (whether directly or indirectly) which is likely to render such water harmful or injurious to

1. Public health or safety.

2. Domestic, industrial, commercial, agricultural or other uses.
3. Life and health of plants, animals or aquatic organisms.

Power and Functions of Board

The Central Board shall consist of the following members:

1. A full time chairman having knowledge or practical experience in matters related to environmental protection or having knowledge and experience in administration of institution dealing with matters aforesaid.
2. Not more than five persons nominated by Central government from amongst the members of State Boards.
3. Not more than five officials nominated by Central government.
4. Two persons nominated by the government to represent the companies or corporations owned by the Central government.
5. Not more than three non-officials nominated by the government to represent interest of agriculture, fishery, etc.
6. One full time Member Secretary (appointed by Central government) having knowledge and experience of scientific engineering or management aspects of pollution control.

Functions of Central Board

1. To advise Central government and state government about the issues related to water pollution.
2. To provide guidance and training to persons in the field of water pollution.
3. To educate people through media, news channels etc. about water pollution.
4. To setup laboratories for analysis samples.
5. To provide technical assistance and guidance to state boards and industries.

Functions of State Boards

1. To advise state government about the issues related to water pollution.
2. To provide guidance and training of persons connected with prevention and control of water pollution.
3. To collect the information about the causes, prevention and control methods of water pollution.

1.12 Wild life Protection Act, 1972

This Act was promulgated in 1972. It is therefore, known as the wildlife protection Act 1972.

This Act provides for the protection of birds, animals and plants for all matters that are connected to it. It was amended in 1983, 1986.

Objectives: The main objectives are:

1. To maintain essential ecological processes and life supporting system.
2. To preserve the biodiversity.
3. To ensure a continuous use of species i.e., protection and unservation of wild life.

⇒ **Definition of Important Terms :**

'Wildlife': It includes any animals, bees, butterflies, fish, moths, aquatic and land vegetation which forms part of any habitat.

'Habitat': It Includes land, water or vegetation which is the natural home of any wild animal.

'Hunting' means (i) to capture, kill, poison, share and trap of any wild animal or trying to do so. (ii) to injure, destroy or take away any part of the body such animals and damaging or disturbing the eggs or nests of wild birds and reptiles.

This includes the following steps:

1. Protection of specified plants.
2. Empowering 200 authority with control of 2005 and capture breeding.

3. Setting up and managing sanctuaries and national parks.
4. Restriction and prohibition on hunting of animals.

Under this Act, several conservation projects have been started for specific animals. Such as,

- Lion project started in 1972.
- Tiger project started on April 1, 1973
- Elephant project.
- Crocodile breeding project in 1974.
- Rhino conservation project in 1987.

1.13 Forest Conservation Act, 1927

This Act was promulgated in 1980. So, therefore known as the forest conservation Act 1980. This Act was amended in 1988.

Objectives: It has the following objectives :

1. Protection and conservation of forests.
2. To ensure judicious use of forest products.

Definitions of the Important Terms

1. **Forest :** Forest is a biotic community composed of trees, shrubs and woody climbers.
2. **Forest Produce :** It includes timber, leaves, fruits, flowers, grass, seeds, moss, wild animals, skin, tusks, horns, silk, bones, honey, wax, peat, rock, mineral etc.
3. **Forest Offence :** Means an offence punishable under this Act or under any rule made in this Act.
4. **Forest-Officer :** Means any person appointed by state government for the purpose of carrying out the duties and objectives under this Act.

Power of the Forest Officer

- Power to stop ways and water courses in reserved forest.
- Power to issue notification reserving trees.
- Power to issues notification declaring protected forests and making rules for such forests.
- Power to assume management of forests.
- Power to form village forests.
- Power to declare prohibition in forests.

2.1 Functional Concepts of Ecology

The two components of nature, organisms and their environment are interdependent, mutually reactive and interrelated. In simple words, Ecology, deals with the various principles which govern such relationships between organisms and their environment.

Following are the basic functional concepts of modern ecology.

1. The basic structural and functional units of nature are ecosystems. Each ecosystem consists of populations and communities. Each population occupies a unique functional position with respect to other organisms, with which it has interaction.
2. There are varying degree of interactions at population as well as community level i.e. competition exists between the population at different levels.
3. There is energy flow at different levels in an ecosystems which is uni-directional and non cyclic.
4. The chemical components of the ecosystem move in definite cycles called hydrological and chemical cycles.
5. Ecosystem undergo process of changes with time, from a less complex to a more complex one. This process involves changes in species composition as well as changes in physical environment. The last or stabilized state is known as the climax.
6. Last stage is the exploitation and disruption of ecosystem as a result of natural condition or activities of man and species diversity of a ecosystem is reduced.

2.2 Basics of a Species

The definition of a species was proposed by Ernst Mayr, according to this :-

"A species is a group of fertile organisms that can interbreed and produce fertile offspring only among themselves". The recent trend is to consider species as the groups of actually or potentially interbreeding natural populations of closely resembling individuals. Thus, a species includes all the individual organisms of a natural population that generally interbreed at maturity in the wild and whose interbreeding produces fertile offspring.

While in many cases this definition is adequate, more precise or differing measures are often used, such as based on similarity of DNA or morphology. Presence of specific locally-adapted traits may further subdivide species into subspecies. Species can also be defined on the basis of various perspectives, which are as follows:

Morphological : A population or group of populations that differs morphologically from other populations. eg. chickens. duck.

Biological : A set of actually or potentially interbreeding populations. Or two organism that are able to reproduce naturally to produce fertile offsprings.

The biological species concept explains why the members of a species resemble one another. When two organisms breed within a species, their genes pass into their combined offspring. As this process is repeated, the genes of different organisms are constantly shuffled around the species gene pool. The shared gene pool gives the species its identity. By contrast, genes are not (by definition) transferred to other species and different species therefore take on a different appearance.

Ecological : A set of organisms adapted to a particular set of resources called a niche in the environment.

Genetic : Based on similarity of DNA of individuals or populations.

Phylogenetic : a group of organisms that shares an ancestor, a lineage that maintain its integrity with respect to other lineages through both time and space. Species is the highest taxonomic level.

A species is considered to be the smallest, most basic unit of classification in most of the systems. It was thought to be an indivisible, stable and static unit (taxon). However, in modern taxonomy, sub-divisions of species, such as sub-species and populations, have been created which aid in our understanding through classification.

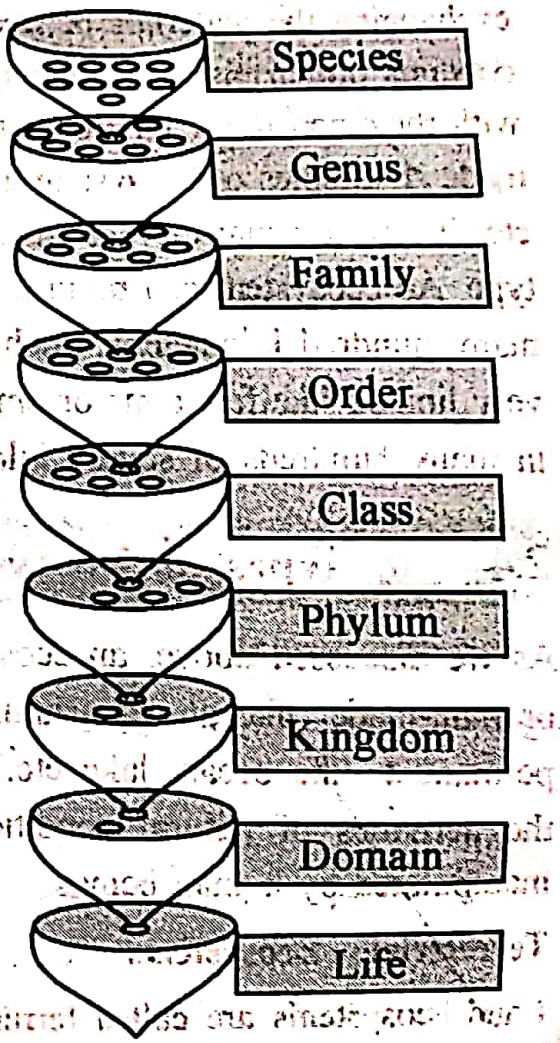

Figure 2.1 The hierarchy of scientific classification

2.2.1 Binomial Convention for Naming Species

In biology, a species is one of the basic units of biological classification and a taxonomic rank. Each species is placed within a single genus. All species are given a binomial name consisting of the generic name and specific name. For example *Homo sapiens* belong

to human beings. Here, *Homo* is the genus of humans whereas, *sapiens* is the species of humans. The name of the species is the whole binomial, not just the second term (which may be called specific name for animals).

2.3 Ecosystem

The term ecosystems was introduced by Sir Arthur Tensely in 1935. An ecosystem can be defined as "a structural and functional unit of biosphere or ecology consisting of community of living organisms and their physical environment both interacting and exchanging the materials between them" or in other words "ecosystems is an area that contains organisms, e.g.. plants, animals, bacteria etc. interacting with one another and with their non living environment". An ecosystem may be big or small, natural or man-made. Examples of ecosystem are a forest, a grassland, a desert, a lake, a river, a pond etc. There are many types of ecosystem on our earth. They are small and large both type. An ecosystem can be in a limited area like few square millimeter or can extend to many hundred kilometers. Such as, for micro-organisms or bacteria, the ecosystem is very limited like few mm^2 or cm^2 area. On the other hand a desert ecosystem may exist in many hundreds of square kilometer area.

2.4 Types of Ecosystem

As we discussed above, an ecosystem may be natural (like forest, sea, grassland etc.) or man-made (like an aquarium, crop field etc.) or temporary (like, rainfed pond) or permanent (like ocean, lake etc.). The natural ecosystem operates automatically under the activities of natural conditions, but the artificial ecosystems are controlled and manipulated by human beings.

Terrestrial Ecosystems

Land ecosystems are called terrestrial ecosystem and consist of a main vegetation. For example, if the main vegetation in an ecosystem is grass, then the ecosystem will be known as "grassland ecosystem".

Aquatic ecosystems are mainly related to freshwater type or marine type ecosystems.

Classification of different ecosystems is shown below:

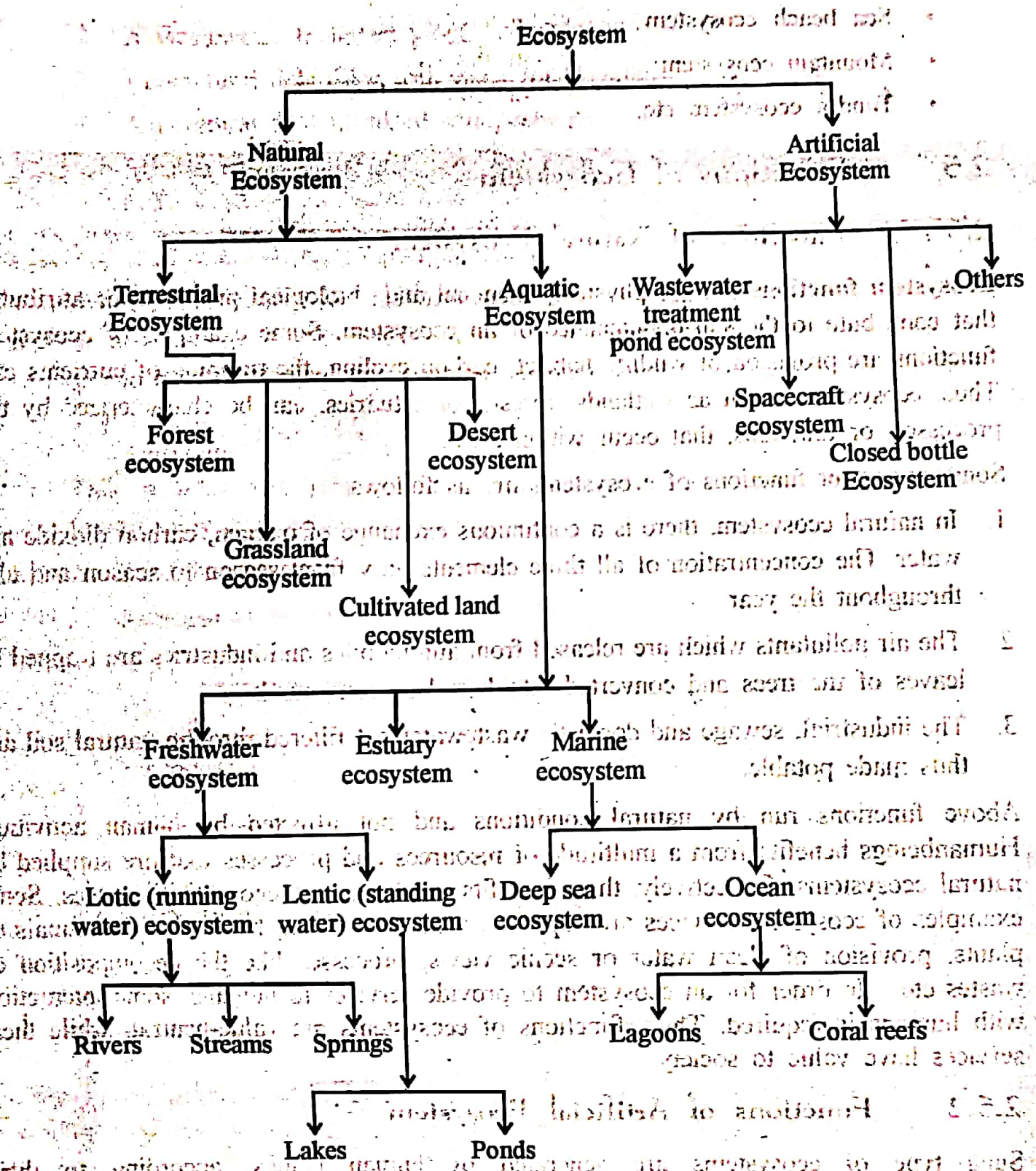

Figure 2.2 Classification of different ecosystems

2.5 Functions of Ecosystem

2.5.1 Functions of Natural Ecosystem

Ecosystem functions are the physical, chemical and biological processes or attributes that contribute to the self-maintenance of an ecosystem. Some examples of ecosystem functions are provision of wildlife habitat, carbon cycling, the trapping of nutrients etc. Thus, ecosystems, such as wetlands, forests, or estuaries, can be characterized by the processes, or functions, that occur within them.

Some important functions of ecosystems are as follows :

1. In natural ecosystem, there is a continuous exchange of oxygen, carbon dioxide and water. The concentration of all three elements vary from season to season and also throughout the year.
2. The air pollutants which are released from automobiles and industries are trapped by leaves of the trees and converted into harmless compounds.
3. The industrial, sewage and domestic wastewater get filtered through natural soil and thus made potable.

2.13 Hydrological and Chemical Cycles in Ecosystem

The producers of an ecosystem take up several basic inorganic and organic nutrients from their non-living environment. They are utilised by the consumer and ultimately return to the environment, with the help of reducers or decomposers. This cyclic exchange of nutrient material between the living organism and their non living environment is called **biogeochemical cycle.**

Some Biogeochemical Cycles are as follows :

2.13.1 Water Cycle or Hydrological Cycle

The water cycle describes the existence and movement of water on, in and above the Earth. Earth's water is always in movement and is always changing state among liquid, vapor and ice at various places in the water cycle.

Process of Water Cycle

The sun heats water in the oceans. Some of it evaporates as vapor into the air. Ice and snow can change directly into water vapor. Rising air currents take the water vapor up into the atmosphere along with water which is transpired from plants and evaporated from the soil.

The vapor rises into the air where cooler temperatures cause it to condense into clouds. Air currents move clouds around the globe. Cloud particles collide, grow and fall out of the sky as precipitation, i.e. rain, snow, hail etc.

Some precipitation falls as snow and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. In warmer climates, melt when spring arrives and the melted water flows overland as snowmelt.

Most precipitation falls back into the oceans or onto land, where, due to gravity, the precipitation flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with streamflow moving water towards the oceans. Runoff and ground-water seepage accumulate and are stored as freshwater in lakes. Not all runoff flows into rivers. Much of it soaks into the ground as infiltration.

Some water infiltrates deep into the ground and stored in saturated subsurface rock, which store huge amounts of freshwater for long periods of time. Some infiltration stays close to the land surface and can seep back into surface-water bodies (such as pond, lake, oceans etc.) as ground-water discharge and some ground water finds openings in the land surface and emerges as freshwater springs.

Over time, the water continues flowing, some to reenter the ocean, where the water cycle renews itself.

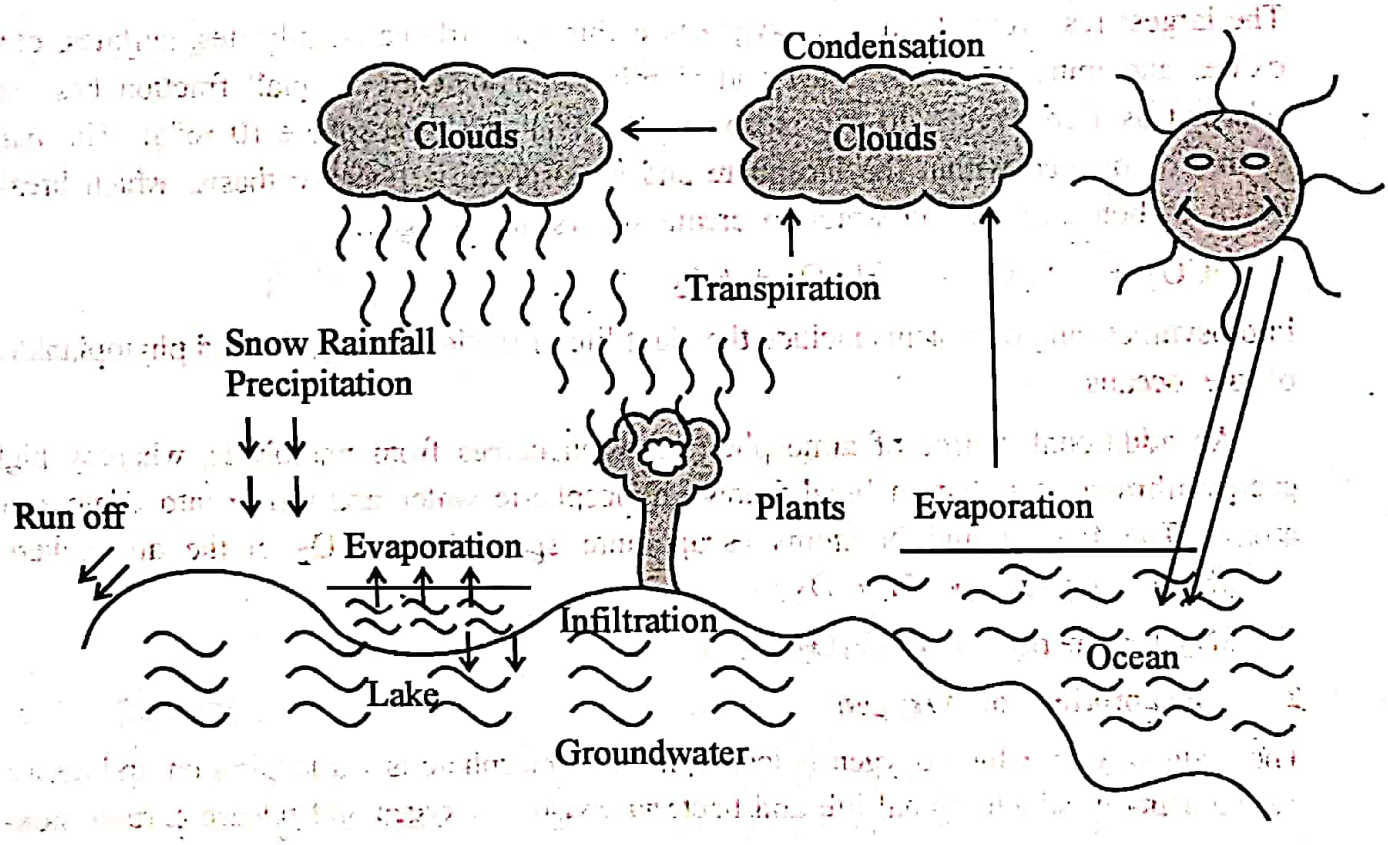

Figure 2.15 Water cycle

2.13.3 Carbon Cycle

Atmospheric CO_2 is fixed as starch by plants during photosynthesis. From there, carbon moves along the food chain through consumers at different trophic levels. After the death of plants and animals the carbon present in their bodies moves into the decomposers. Huge quantities of CO_2 are known to be put back into the atmosphere through oxidation by various groups of bacteria and fungi. Atmospheric CO_2 is also used up by algae and

autotrophic bacteria to manufacture carbohydrates. During respiration of terrestrial plants and animals and humans, atmospheric oxygen is used up and CO_2 is put back into the atmosphere.

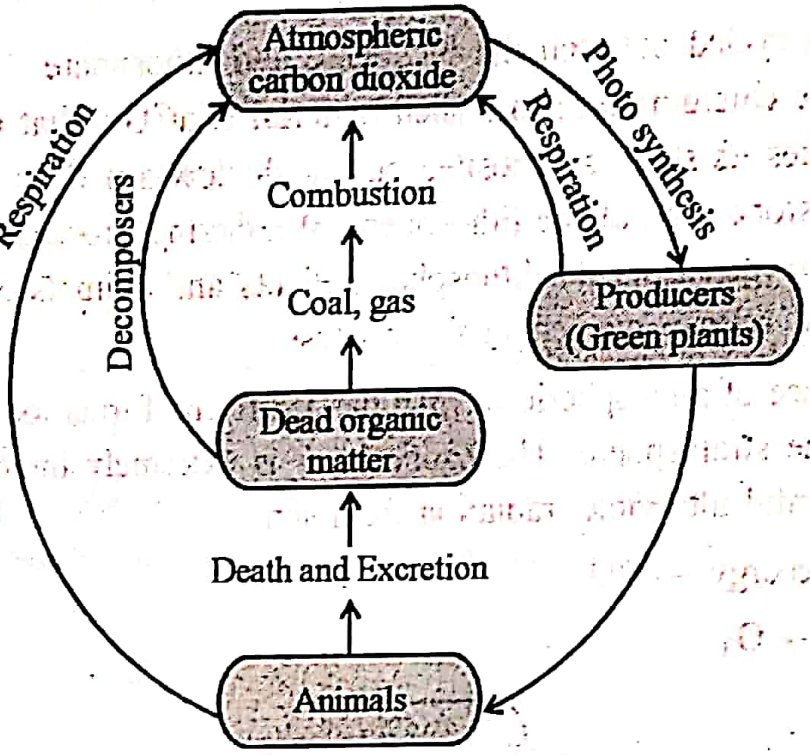

Figure 2.17 Carbon cycle

2.13.4 Nitrogen Cycle

Nitrogen accounts for about 79% of earth's atmosphere. It is very important for life because it is a structural part of all amino acids, proteins, nucleic acids and of chlorophyll molecules which is important for photosynthesis. Atmospheric nitrogen remains in the atmosphere in its elemental form (N_2) which cannot be used as such by living organisms thus, it has to be fixed, i.e. it is to be combined with other elements such as hydrogen, carbon, or oxygen to convert it into usable form for green plants.

The **nitrogen cycle** is the biogeochemical cycle that describes the cyclic flow of nitrogen and nitrogen-containing compounds in nature.

Consumption of atmospheric nitrogen

The main component of the nitrogen cycle starts with the element nitrogen in the air. The nitrogen oxides (i.e., NO, NO_2, N_2O) are formed in the air as a result of interactions with oxygen. Nitrogen react with oxygen only in the presence of high temperature and pressure found near lightning and in combustion reactions in power plants or internal combustion engine. Nitric oxide, NO and nitrogen dioxide, NO_2, are formed under these conditions. Eventually nitrogen dioxide may react with water in rain to form nitric acid, HNO_3. The nitrates thus formed may be utilized by plants as a nutrient.

Nitrogen in the air becomes a part of biological matter mostly through the actions of bacteria and algae in a process known as **nitrogen fixation.** Legume plants such as clover, alfalfa and soybeans form nodules on the roots where nitrogen fixing bacteria take nitrogen from the air and convert it into ammonia, NH_3. The ammonia is further converted by other bacteria (e.g. *Nitrosomonas* species) first into nitrite ions (NO_2^-) and then (*Nitrobacter*) into nitrate ions (NO_3^-). Plants utilize the nitrate ions as a nutrient or fertilizer for growth. Nitrogen is incorporated in many amino acids which are further reacted to make proteins.

Ammonia is also made through a synthetic process called the Haber process. Nitrogen and hydrogen are reacted under great pressure and temperature in the presence of a catalyst to make ammonia. Ammonia may be directly applied to farm fields as fertilizer. Ammonia may be further processed with oxygen to make nitric acid. The reaction of ammonia and nitric acid produces ammonium nitrate which then may be used as a fertilizer. Animal wastes when decomposed also return to the earth as nitrates.

Nitrogen production

To complete the cycle, other bacteria (i.e. *Pseudomonas* and *Clostridium*) in the soil carry out a process known as denitrification which converts nitrates back to nitrogen gas.

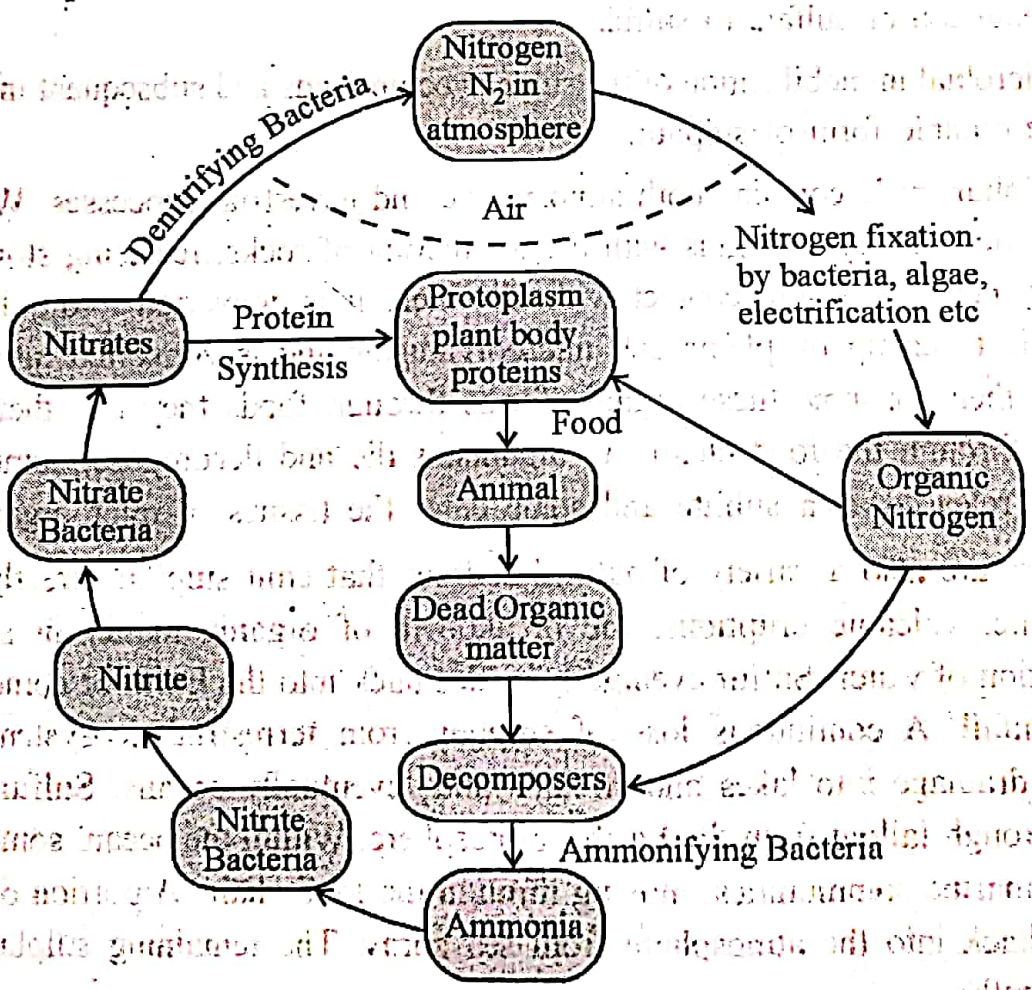

Figure 2.18 Nitrogen Cycle

A side product of this reaction is the production of a gas known as nitrous oxide, N_2O. Nitrous oxide, also known as "laughing gas" - mild anaesthetic, is also a greenhouse gas which contributes to global warming.

Dinitrogen gas is also formed via anaerobic ammonium oxidation. In this biological process, nitrite and ammonium are converted directly into dinitrogen gas. This process makes up a major proportion of dinitrogen conversion in the oceans.

2.13.6 Phosphorus Cycle

Phosphates are necessary for the growth and maintenance of animal bones and teeth while organo-phosphates are essential for cell division involving the production of nuclear RNA and DNA.

Phosphate minerals are located in rocks and soil, where phosphates exist in soluble and insoluble forms. Terrestrial plants absorb inorganic phosphate salts from soil and convert these into organic phosphates. Animals obtain their phosphate by eating plants. Plants and animals after their death and decay return phosphates to the soil, which are finally converted to humus by the action of soil micro-organisms. Bulk of the phosphate in the soil is fixed or absorbed on to soil particles, but part of it is lost through leaching (run off) into water courses.

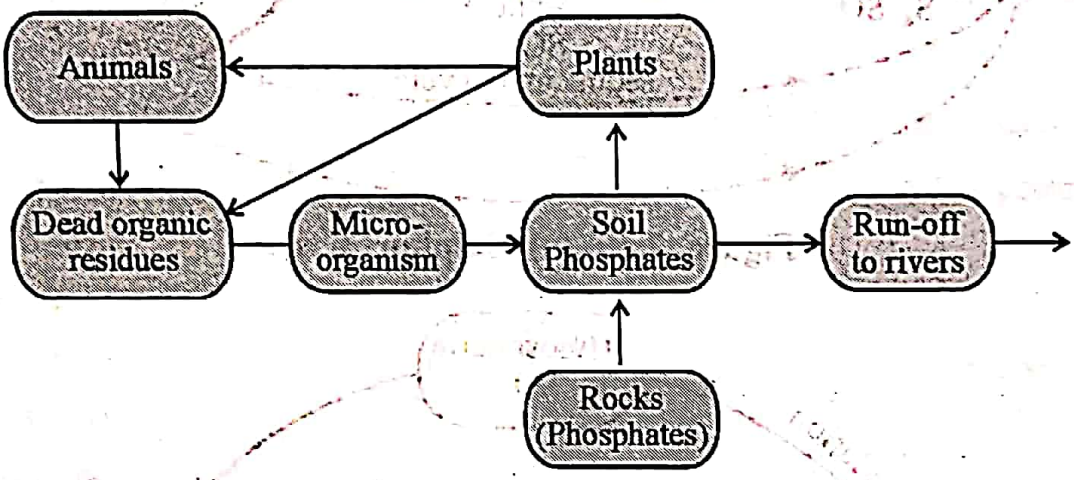

Figure 2.20 Phosphorous cycle on land

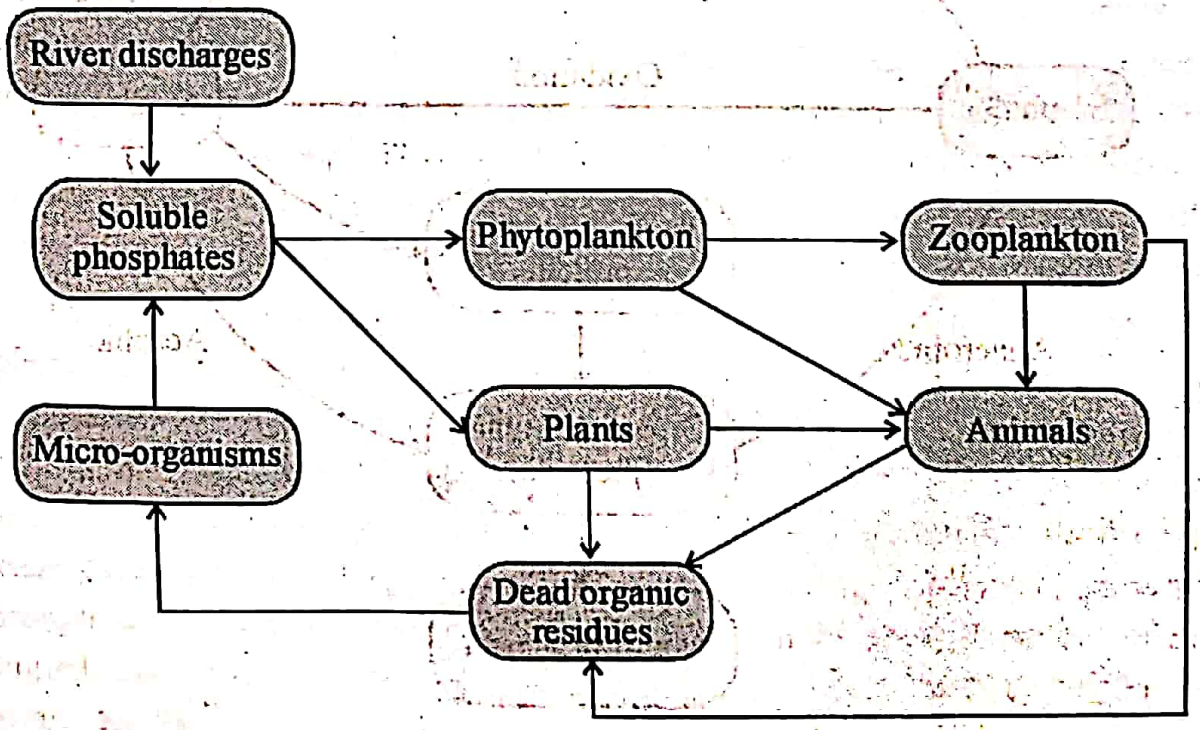

Figure 2.21 Phosphorous cycle in water

3.1 Introduction

The word 'biodiversity' means 'the variety and variability of life' or the other meaning of biodiversity is 'varieties of biological species'. In broad reference biodiversity refers to the studies of all forms of life.

These include the life forms given as under :

1. Unicellular organisms such as: Fungi, bacteria and Protozoa.
2. Multicellular organisms such as: Fishes, birds, mammals and plants.

3.2 Types of Biodiversity

Since the life forms, i.e. species in different ecosystem are basically made up of genes, therefore, biodiversity may be classified into the following types :

1. Genetic diversity
2. Species diversity
3. Ecosystem Diversity

3.2.1 Genetic Diversity

Gene is the most basic structure of species. The genetic variation existing within the species is called genetic diversity. These genes influence characteristics of all species. The genetic variation may be in alleles (different variants of same gene), in entire genes (the traits determining particular characteristics) or in chromosome structures. To name a few of these, the characteristics are: size, colour, boldness, aggressiveness, shape, resistance against a disease, hot and cold weather sustainability for survival against different environment etc. Thus, a species (like dog) may be smaller or bigger in size, white or brown in colour, may be aggressive or calm in nature etc. Such different characteristics of same species are known as **'genetic diversity'**. Species having a large number of varieties or races are considered to be more diverse, i.e. rich. For example, the rose flower is available in hundreds of varieties, means it has a rich diversity. The genetic diversity within species often increases with environmental variability. The evolution of new species, i.e. speciation, depends upon the amount of genetic variation.

3.2.2 Species Diversity

It refers to the variety of species within a region. It includes the full range of species in the region, from micro-organism to multicellular plants and animals. More the number of species, greater is the species diversity. The species diversity of a region is measured on the basis of two parameters. These are:

Species richness and equitability/evenness.

Species richness refers to the number of species per unit area. The number of species increases with the area of the site. **Evenness or equitability** shows the evenness in the number of individuals of the species. The evenness of species represents higher species diversity in the region. Let us consider a situation of three sample areas. In the first sample area, there are three species of birds. One specie has four individuals while the other two have one each. In sample area 2, we have the same three species having two individuals each. It shows more even and every species has a chance to be represented in a sample. So, sample two is more diverse than the first. Sample 3 has six individual two each from a bird, mammal and an insect. This sample area is most diverse among the three. In above example, each sample area shows equal number of species but varying number of individuals per species. Thus, both the number or kind of species as well as the number of individuals per species decide the species diversity of an area.

3.2.3 Ecosystem Diversity

Depending upon the availability of abiotic resources, an ecosystem develops its own community of living organisms. **Ecosystem diversity** refers to the variation in the structure and functions of the ecosystems. It describes the number of niches, trophic levels and various ecological processes that sustain energy flow, food webs and the recycling of nutrients. The ecosystems like grassland, rain forest, desert, lake and ocean are major ecosystems, where species live and evolve. The number of habitats or ecosystems may vary within a geographical region. It is the measure of ecosystem diversity in a region.

3.4 Importance of Biodiversity

Human beings totally depend on natural biodiversity and they derive many direct and indirect benefits from living world. Biodiversity is the source of food, medicines, pharmaceuticals, fibres, rubber, timber etc. and several microorganisms are also used in industries to obtain valuable products. The important uses of biodiversity are as follows :

1. Source of Food and Improved Varieties

Modern agriculture uses biodiversity as a source of new crops, source material for breeding to produce improved varieties and source of new biodegradable pesticides. There are thousand of species which are edible but only less than 20% species are cultivated to produce about 85% of the world food. Wheat, rice and maize are three rich crops which constitute two-third of food for mankind.

Improved varieties of crops and animals are the main source of modern agriculture. Few years ago, through breeding programmes, many improved varieties of crops and plants have been developed. For example, in Asia, rice cultivated is protected from the four main diseases by the genes received from a single wild rice species from India.

2. Sources of Drugs and Medicines

Medicinal plants are very useful for living world. Large number of medicines are obtained from plants. Some of the plant based substances are used as valuable drugs such as :-

(a) **Morphine,** extracted from ***Papaver somniferum*** is used as an analgesic or pain killer.

(b) **Quinine** obtained from ***Cinchona ledgeriana*** is used for treatment of malaria.

(c) **Taxol** obtained from the bark of ***Taxus baccata*** and ***T. brevifolia*** used as an anticancer drug.

(d) **Reserpine** extracted from ***Rauwolfia serpentina*** is used for the treatment of high B.P. (Blood Pressure)

3. Aesthetic and Cultural Uses

The nature has created a large number of species. Many of them are versatile in different aspects. Biodiversity is also related to our cultural and religious beliefs. Tulsi (*Ocimum sanctum*) is worshipped in many parts of India. Similarly, Pipal, Deodar, Khejri etc. are some other plants worshipped and, hence, conserved. Various plant species also provide a good deal of fun and recreation, e.g. many flowers are gifted and held as symbols of love and respect; buildings are maintained eco-friendly by the potted plants kept inside the rooms.

4. Ecosystem Services

Biodiversity is essential to keep natural cycles going on and make the ecosystem self sustaining. Some of these services of ecosystem are:

(a) Air purification value, i.e. maintenance of gaseous composition of the atmosphere.

(b) Climate control value by forest and oceanic systems.

(c) Soil formation.

(d) Protection value.

(e) Conservation and purification of water.

(f) Cycling of nutrients.

5. Ethical Value

Human beings, being the most intelligent species on earth, cannot ignore the duty to keep the continuance of all forms of life on earth. Similar to religions, the ethical values are part of our culture. Therefore to preserve these values, conservation of biodiversity is essential.

6. Social Value

These includes the social life, customs, religion and physico-spiritual aspects of the people. Thus, peapal, mango, lotus, beal etc. Plants are considered holly and sacred in our country the leaves, fruits, flower of these plants are use in worship is the plant itself in worshipped.

7. National Value

Among all types of species, a few attain national importance also. Accordingly, they are valued as national bird, national flower, national animal etc., e.g.

National bird of India - Peacock

National flower of India - Lotus

National animal of India - Tiger

3.5 Threats to Biodiversity

Some of the threats to biodiversity are as follows:

1. Habitat Loss and Fragmentation

The most important reason for the loss of biodiversity is the destruction of the habitat. Habitat loss and fragmentation are the processes where a large continuous area of habitat is divided into two or more fragments. It may limit the dispersal and colonization potential of species. It makes some species more vulnerable to extinction. A forest patch near a crop land is an example of fragmented habitat. Over exploitation of species also makes them vulnerable to extinction.

2. Pollution and Disturbance

Man-made and natural disturbances like, fire, tree fall, etc. effect the communities adversely. Man-made and natural disturbance both are different from each other in intensity, rate and spatial extent.

4.1 Introduction

Energy, being an essential input for every activity, has always been an inseparable pa of everyone's life. It is the primary and most universal measure of all kinds of work b human beings and nature. Various energy sources have been used to produce energy industries, agriculture, transport, household works etc. The main aim is the welfare mankind.

Energy sources can be broadly divided into two major categories. Renewable and n renewable energy sources which can be divided further into many sub categories. The are shown below:

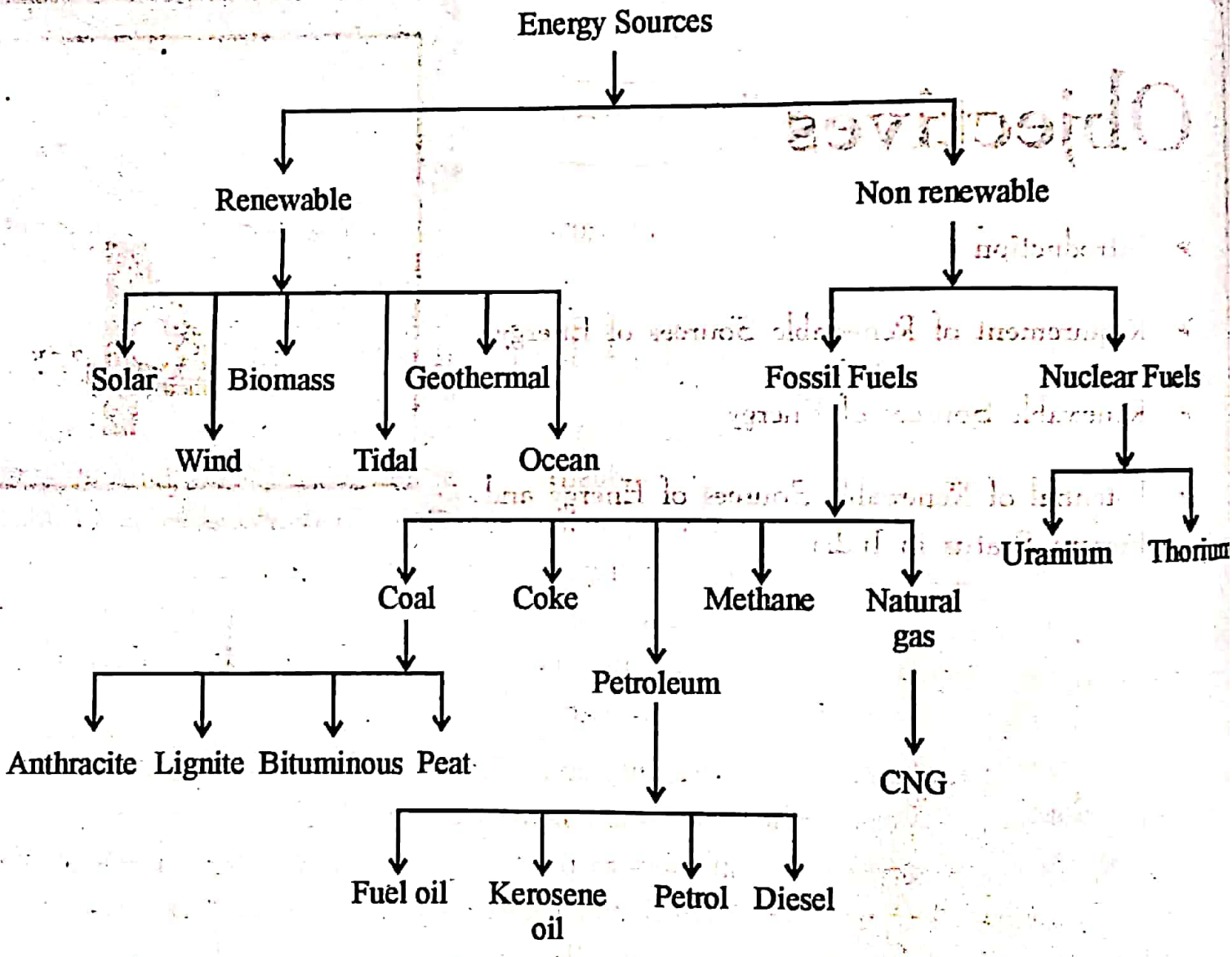

Figure 4.1 Classification of renewable and non renewable energy sources

The percentage use of various sources for the total energy consumption in world is give in fig. 4.2.

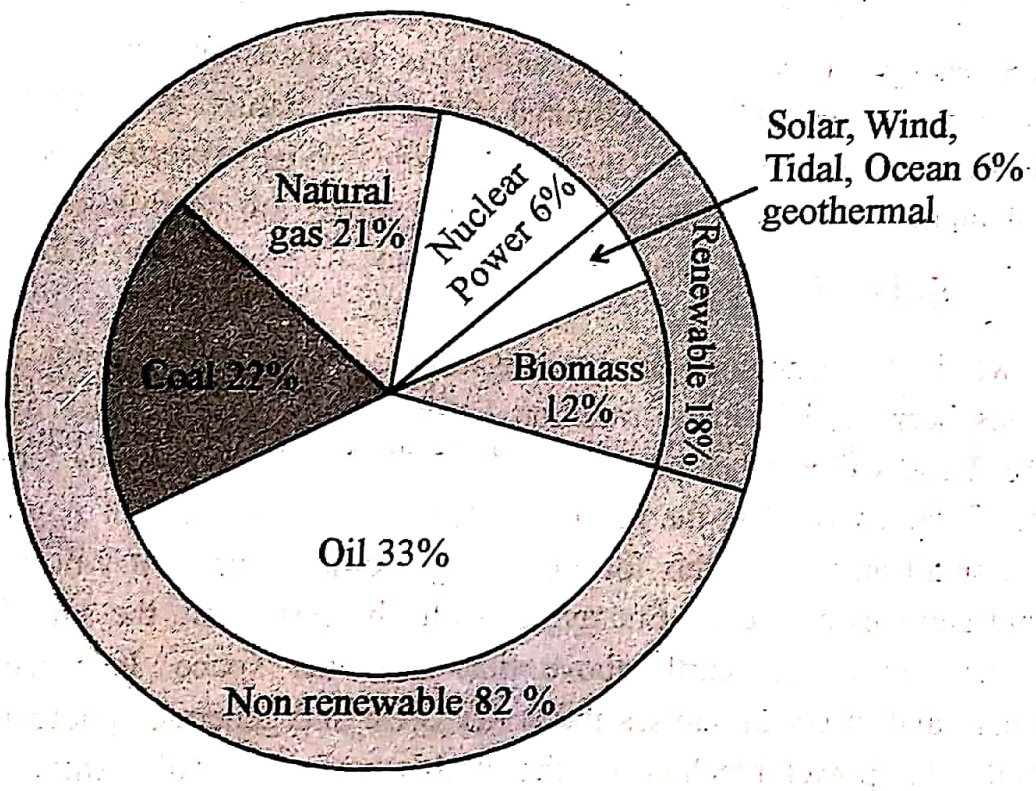

Figure 4.2 Percentage use of various sources of total energy consumption in the world.

4.3 Renewable Sources of Energy

Renewable energy sources are also known as inexhaustible energy sources because these sources are available in unlimited amount in nature and can be renewed over relatively shorter time period. Along with it, these can be harvested continuously through proper planning. The main renewable energy sources are as follows:

DETAILED LECTURE NOTES

Campus: ..... Course: ..... Class/Section: ..... Date: .....
Name of Faculty: ..... Name of Subject: ..... Code: .....

RENEWABLE SOURCES OF ENERGY

Renewable energy sources are also known as inexhaustible energy sources bcz these sources are availble in unlimited amount in nature & can be renewed over relatively shorter time period.

The main renewable energy sources are as:

1. Solar Energy
2. Wind Energy
3. Biomass Energy
4. Tidal Energy
5. Geothermal Energy
6. Ocean thermal Energy

1. SOLAR ENERGY

Solar power is the technology of obtaining usable energy from sunlight. Solar energy has been used in many traditional technologies for centuries It has great potential of all sources of renewable energy Energy comes to the earth from sun. This energy keeps temp. of easth above than cold places. The solar energy can be stored by ~~producing~~ storing in mechanical or electrical devices.

Page No

Applications of solar Energy

(a) Solar Heating system
(b) Solar cooking, lighting
(c) Heating naturally to buildings
(d) Solar furnace

2. WIND ENERGY

- Wind is also a renewable source of energy.
- Wind turbine convert power of wind to electrical Energy.
- Wind is generated due to Heating – cooling of atmosphere which generate convection currents causing wind and due to rotation of earth.
- It is non polluting renewable energy.
- Wind mills are set up for the generation of energy.

3. BIOMASS ENERGY

- Biomass E. is the energy produced from organic matter.
- Wood is our laggest biomoss energy source.
- It is used as burning of wood for cook & keeping house warm.
- Biomass is produced in nature through photosynthesis in presence of sunlight.
- Biomass also include young/old plants, their residue, waste, wood, plant, marine & fresh water algae, Grasses, agriculture residue, biodegradable coast.

DETAILED LECTURE NOTES

PAGE NO. .....

Types of Biomass resources:

(a) Traditional - Wood, agricultural residue.

(b) Non-traditional - which converted in to other forms

(c)

4. TIDAL ENERGY

- Tides in the sea are formed due to gravitational effect of the sun and moon on the earth.
- Gravitational force causes a periodic rise & fall of the water level of sea which is in rhythm with the daily cycle of rising & setting of sun & moon
- It has a great potential & can form a sources of renewable energy to produce clean electricity.
- Total power of lunar tides is $(2 \text{ to } 5) \times 10^6$ MW
- Lunal day consists of 24 hrs 50 minutes and in one lunar day, water in oceans and seas rise and fall twice.
- The height of tides is diff. at diff places on the earth and depends upon the lattitude & topography of coast. The tidal power plants in India are situated at gulf of Cambay, gulf of kutch in Gujrat etc.

5. Geothermal Energy

- Geothermal energy is an enormous, underused heat and power resource that is clean & reliable.
- The heat energy is transfered to a working fluid which operates power cycle.
- The heat is obtained from the magma (hot molten lava) which is located near earth surface.
- Geothermal energy reservoirs are liquid dominated and steam dominated and steam dominated

SOLID WASTE MANAGEMENT

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TOPICS

- Solid Waste and Solid waste management
- Objectives of Solid waste management
- Classification of solid waste
- Collection of SW
- Methods of collection of Solid waste
- Collection routes
- Transportation of Solid Waste
- Transport station
- Disposal of solid waste

MUNICIPAL SOLID WASTE MANAGEMENT

Bottom 10 states

State	Daily waste generated (MT)	Waste Proce-ssed
Arunachal	181	0%
D & N Haveli	35	0%
J & K	1,374	1%
Jharkhand	2,327	2%
Odisha	2,650	2%
Bihar	1,318	3%
Puducherry	350	3%
Mizoram	201	4%
West Bengal	7,700	5%
Haryana	4,514	6%

Top 10 states

State	Daily waste generated (MT)	Waste Proce-ssed
Chhattisgarh	1,680	74%
Telangana	7,371	67%
Sikkim	89	66%
Goa	260	62%
Meghalaya	268	58%
Tripura	420	57%
Delhi	**10,500**	**55%**
Manipur	176	50%
Kerala	1,463	45%
Maharashtra	22,570	39%

All states

Daily waste generated (MT) 1,43,558

Waste Processed 24.8%

Source: Times of India, 2019

RECYCLE
REUSE
REDUCE

1. Solid waste and Solid waste management

Solid waste management

1.1 What is Solid Waste

Solid wastes are all the wastes arising from human and animal activities that are normally **solid** and are discarded as useless or unwanted.

Generation of solid waste is not a new phenomenon. It is as old as human civilization. In the early days, before the advent of of Industrial revolution, the major constituents of wastes were **domestic sewage and agricultural** residues, which were bio degradable in nature. Since population was less and fallow and was in plenty, solid wastes could be conveniently disposed off in the country side either on **open ground** or were placed in **pits** covered with layers of earth. Because of their biodegradable nature they used to get **decomposed** and assimilated in the soil.

However, with unparallel industrialization and consequent organization not only has the quantity of solid waste increased but its quality has also changed.

Though rural wastes continue to be made up of domestic wastes and agricultural residues mainly, waste from urban are as and the industrial units contains **diverse types of materials that include toxic and hazardous constituents.**

The discarded waste materials are often **reusable** and may be considered as resource in another setting.

Solid waste management is to mange the society's waste in a manner that **meets public health and environmental concerns** and the Public's desire to reuse recycle **waste materials.**

2. Objectives of Solid waste management

1.2 Goals and Objectives of Solid Waste Management

The objectives of solid waste management is based on 3R'S i.e. reduction, reuse and recycling. The object of solid waste management requires comprehensive approach for each stage of solid waste **management e.g. generation, collection, processing and final disposal.**

The goal and objectives of solid waste management can be classified as :

(1) Waste minimization: Wastes should be minimized at the source of generation. It can be done by

(i) Minimizing the amount of material used in the manufacture of product.

(ii) Increasing the life of product.

(iii) Reducing the amount of material used for packaging and marketing of consumer goods.

It can also be achieved in household and commercial units through increased public awareness, of improved buying and through reuse of products.

(2) Material Recovery and Recycling : Wastes consists of various materials eg. paper, card board, plastics, glass rubber etc. Many of these components are suitable for

2. Objectives of Solid waste management

recycling and reuses. The process involves separation and collection of these materials, prepartion materials for reuse and manufacture. It reduces the load on disposal facilities and also amount of money can be earned by selling these recovered materials.

(3) Wastes Transformation : It means physical, chemical or biological conversion of wastes for any beneficial purpose. The number of processes such as anaerobic digestion, composting, incineration, pyrolysis etc. are employed for this purpose. Several by products like manure etc. canbe recovered.

(4) Volume Reduction : Volume reduction means size reduction of wastes through shredding, size separation with the help of screening volume reduction through compaction. Volume reduction also reduces land area requirement for its disposal.

(5) Wastes Disposal : There are some wastes that cannot be reused recycled or transformed should be disposed off. Options for disposal may be on land, deep below earth surface, disposal at acean bottom.

(6) Database Management : The database should include composition of wastes, physical, chemical and biological properties of wastes and information regarding equipment, staff and facilities available for collection, transportation and disposal of wastes.

Precise relevant and reliable data are necessary for selection of various treatment and disposal techniques.

Now with the help of remote sensing, geographic information system (GIS) etc. it is possible to collect data and make it accessible to the users instantaneously.

Problems associated with SW

Problems associated with SW

1.3 Problems Associated with Solid Waste Disposal

Unless properly managed solid waste disposal has following problems

(i) It can lead to surface and ground water contamination land pollution and air quality deterioration.

(ii) Water infiltrating through the wastes generates leachate, which can ultimately mix with the ground water.

(iii) Dust and litter scattered by wind are responsible for deterioration of air quality in the vicinity of disposal sites.

(iv) Insanitary method of disposal of wastes also produces odor and affects the aesthetics of the area.

(v) Decomposition of wastes relaeases noxious gases posing high risk to human health.

(vi) Large number of disease vectors and water borne disease spread due to poor collection and disposal practices of solid waste.

3. Classification of solid waste

1.4 Classificationof Solid Waste

SOLID WASTE

- Residential and Commercial waste
- Institutional waste
- Industrial waste
- Construction waste
- Municipal Service waste
- Agricultural waste
- Treatment plant waste
- Special category waste
- Hazardous wastes
- Pathological waste

4. Collection of solid waste

Onsite Handling - Onsite handling refers to the activities associated with handling of solid wastes until they are placed in the containers used for their storage before collection.

Factors to be considered during Onsite handling:

1. Type of containers
2. Location of container
3. Public health and aesthesis
4. Collection methods

1. **Type of containers - Plastic ,Galvanized, Disposable paper bags, Disposable plastic bags, medium container, large container, containers with compacters.**
2. **Location of container- Room, Floor, Compound, Community, Street, City**

4. Method Collection of solid waste

3.2 Collection Services

The collection includes not only the gathering or picking up of solid waste from various sources, but also the hauling of these wastes to the location where the contents of the collection vehicles are emptied. Unloading of collection vehicle is also the part of collection operation.

While the activities associated with hauling and unloading are similar for most collection systems, the gathering or picking up of waste will vary with the characteristics of the facilities, activities, or locations where wastes are generated and the ways and means used for onsite storage of accumulated wastes between collections.

3.3 Collection Methods

Collection includes all activites associated with gathering of solid wastes and the hauling of the waste collected inthe loaction from where collection vehicle will ultimately transport it.

There are three methods of collection.

(1) Community storage point

The municipal solid wste is taken to fixed storage bins and stored till waste collection agency collects it daily for disposal in vehicle.

(2) Kerbside collection

In this collection system refuse is brought in containers and placed on the footway from where it is collected by waste collection agency. Materials are collected in large bins, coloured bags or small plastic tubes, specifically designated for content.

(3) Block collection

Individuals bring the waste in containers and hand it to the collection staff who empties it into the waiting vehicle and returns the container to the individuals. The collection truck and crew makeup the most important element of collection system. Collection trucks used are of enclosed, compacting type. Compaction in a collection vehicle temporarily reduce the refuse volume by 80%.

Mechanical collection system

Mechanical collection system are becoming popular in many communities because of improved aesthetics of kerb side container placement as well as low cost. These systems consists of standardised containers and truck mounted lifting mechanism. In

4. Method Collection of solid waste

1. **Self Haul system**
2. **Rural collection systems**
3. **Urban collection system**
4. **Regional collection system**
5. **Collection of recyclables**

Types of Collection system

- Haul container system (HCS)

- Stationary container system (SCS)

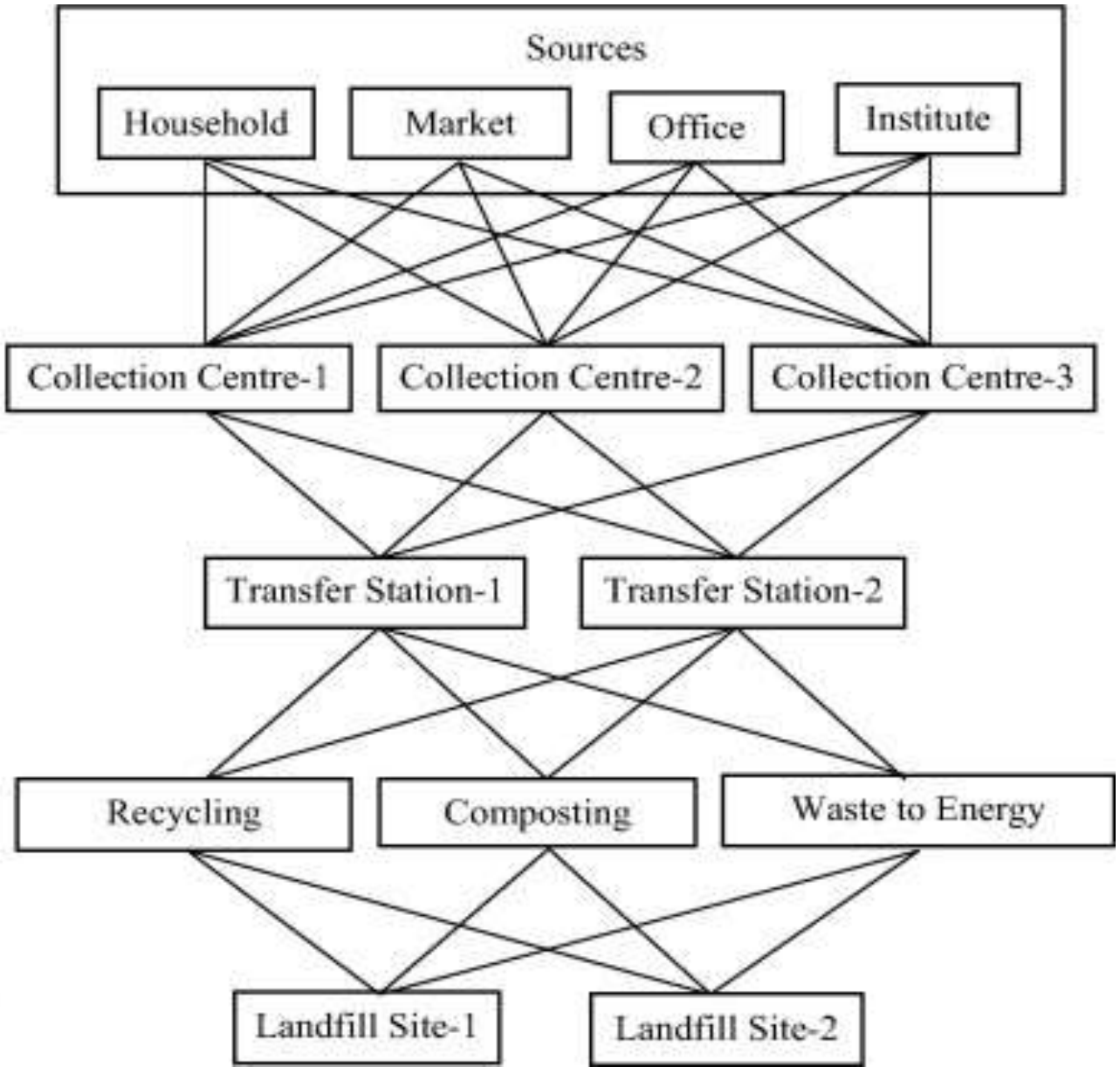
STEPS OF SOLID WASTE MANAGEMENT

Step 1

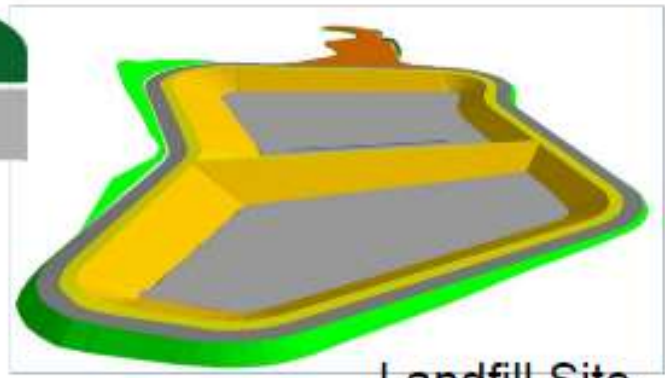
Step 2

Step 3

Step 4



Processing
Plant



Landfill Site

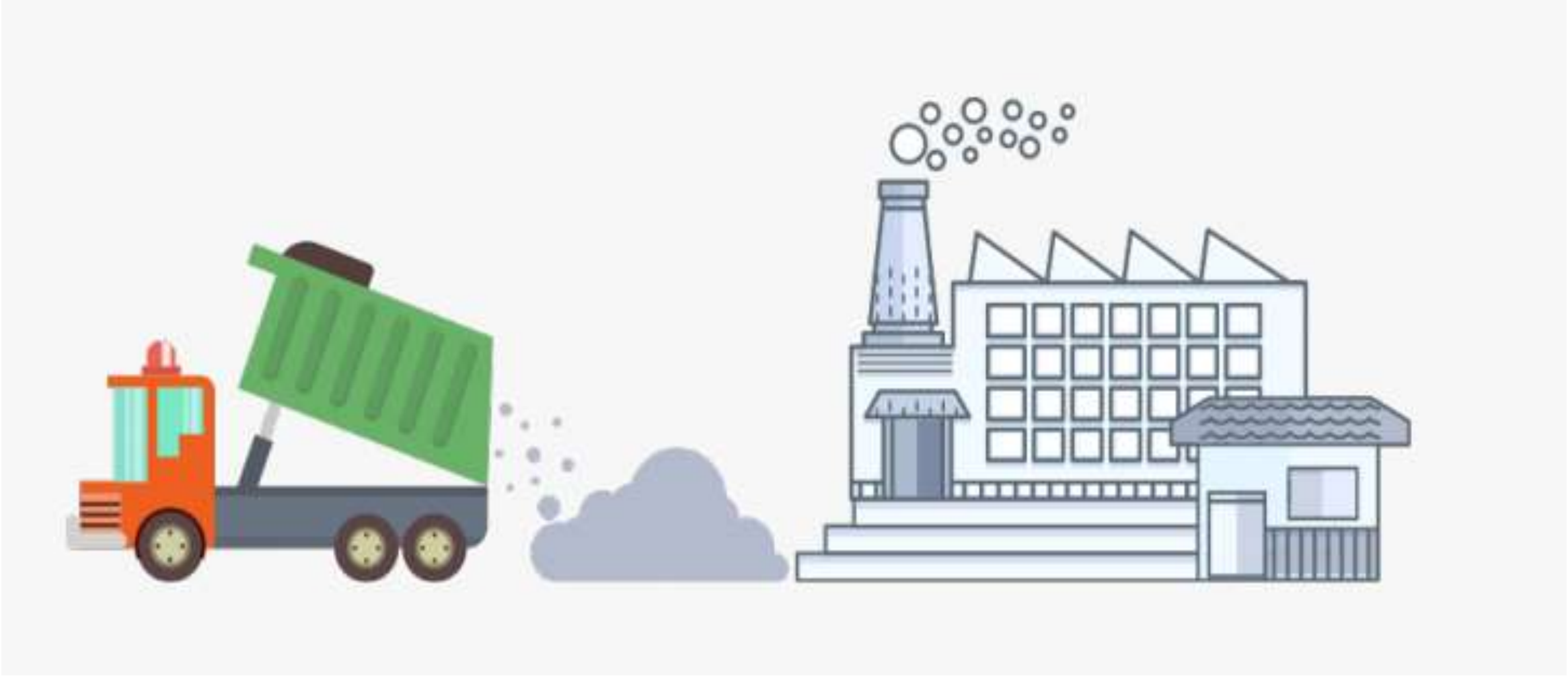
5. Collection routes

3.7 Collection Routes

Cost of of transportation forms a substantial part of the overall budget in the waste management system. The transportation route of vehicles should therefore be carefully optimized both from environmental and economic point of view.

Routing can be defined as the detailed assignment of MSW collection vehicles and labour to collection routes such that collection efficiency is maximized. Routing includes the actual route that a vehicle should take to minimize either the distance that it covers or time that is taken to complete collection assignment.

Transportation of SW



5. Transportation of SW

3.8 Transfer and Transport

These element involves two steps

(a) The transfer of wastes from the smaller collection vehicle to the larger transport equipment.

(b) The subsequent transport of the wastes, usually over long distance to a processing or disposal site. 'Transportation vehicle' means any vehicle, including but not limited to, trucks, transfer trailers, barges, or rail cars that are used to move solid waste from transfer station to a permitted solid waste handling facility or to another transfer station.

3.9 What is Transfer Station

A waste transfer station is a light industrial-type facility where trash collection trucks discharge their loads so trash can be compacted and then reloaded into larger vehicles (e.g., trucks, trains and barges) for shipment to a final disposal site, typically a landfill or waste-to-energy facility. Transfer station operators usually move waste off the site in a matter of minutes or hours. Transfer stations serve both rural and urban communities. In densely populated areas, they are generally fully enclosed.

5. Transport station

3.9.3 Types of Transfer Stations

Transfer stations may be classified with respect to capacity as follows : Small, less than 100 tons/day, medium between 100 and 500 tons/per, large, more than 500 tons/day.

Important factors that must be considered in the design of transfer stations include:

(a) Type of transfer operation to be used

Transport methods:

Motor vehicles transport
Front loaders
Rear loader
Container trucks

5. Transport station

(b) Capacity requirements

(c) Sanitation requirements

(d) Equipment and accessory requirements

Depending on the method used to load the transport vehicles, transfer stations may be classified into three types

(i) Direct discharge

(ii) Storage discharge

(iii) Combined direct and storage discharge.

Direct discharge

In large capacity direct discharge transfer station, the wastes in the collection vehicles are implied into the vehicle to be used to transport to a place of final disposition.

In medium and small direct discharge transfer stations both stationary compactor and open top container are used. Compressible items are discharged into stationary compactor hopper and bulky items, such as refrigerators are discharged into the open top container.

Storage discharge

In the storage discharge transfer station, wastes are emptied either into a storage pit or onto a platform from which they are loaded into transport vehicles by various types of auxiliary equipment.

Combined direct and storage discharge

In some transfer stations, both direct discharge and storage discharge methods are used. Usually these are multipurpose facilities designed to service a broader range of users than a single purpose facility.

6. Disposal of solid waste

4.1 Processing Techniques and Methods of Disposal

Solid waste processing reduces the amount of material requiring disposal and, in some cases, also produces a useful product. Examples of solid waste processing **technologies include material recovery facilities, where recyclable materials are removed and/or sorted; composting facilities where organics in solid waste undergo controlled decomposition; and waste to energy facilities where waste becomes energy for electricity.**

Once the waste is collected from different sectors the next step is regarding the safe, economical and efficient disposal options.

Suitable decisions have to be made to avoid open and illegal dumping of wastes which are dangerous to the environment. Open dumps attracts vectors, contain materials that are dangerous to human and other living beings, contaminate surface and ground water, cause fire threat, interrupt drainage patterns.

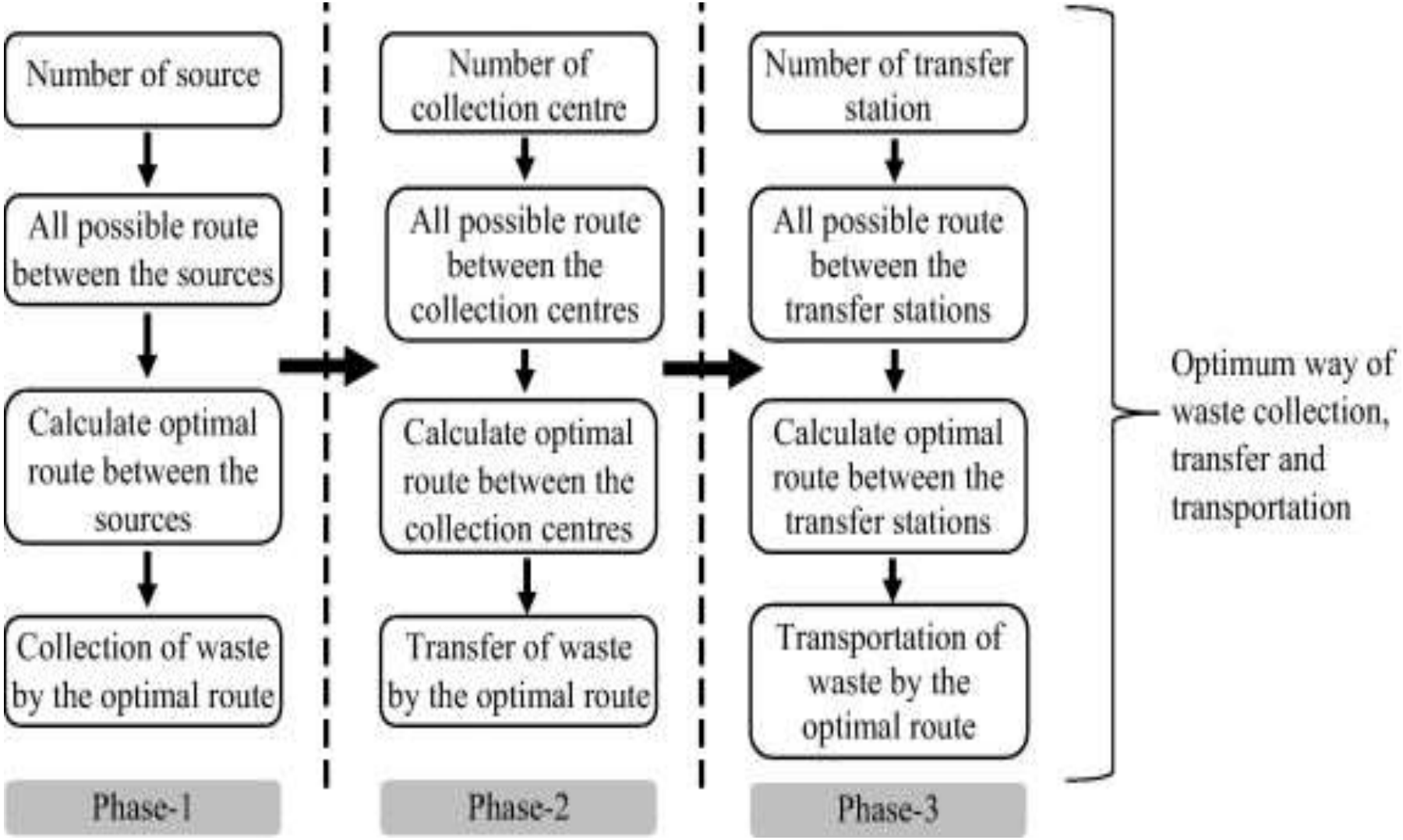
Open burning of waste releases smoke which contains pollutants harmful to human health and environment.

Therefore the community has to face serious incoveninces due to illegal disposal practices. Good solid waste management is the safe disposal options of municipal solid waste (MSW).

Methods commonly employed to dispose municipal solidwaste include composting, waste to energy such as incineration and biogas production and land filling.

Composting and incineation are intermediate solid waste treatment and not final disposal as they produce secondary waste such as non-biodegradable material rejects

WAYS TO OPTIMIZE SOLID WASTE MANAGEMENT



7. Method of Disposal and processing

Open burning
Dumping into the sea
Sanitary Landfills
Incineration
Composting
Ploughing in fields
Animal/Hog feeding
Grinding and discharging into sewers
Fermentation and biological digestion

Open burning of Solid Wastes

Not an ideal method in the present day context

Dumping into Sea

Possible only in coastal cities

Refuse shall be taken in barges sufficiently far away from the coast (15-30 km) and dumped there

Very costly, Not environment friendly

Sanitary Landfilling of Solid Wastes

Simple, cheap, and effective, A deep trench (3 to 5 m) is excavated, refuse is laid in layers

Layers are compacted with some mechanical equipment and covered with earth, leveled, and compacted

With time, the fill would settle

Microorganisms act on the organic matter and degrade them,Decomposition is similar to that in composting

Facultative bacteria hydrolyze complex organic matter into simpler water soluble organics

These diffuse through the soil where fungi and other bacteria convert them to carbon dioxide and water under aerobic conditions

Engineered Landfills of Solid Wastes

Bottom of the trench is lined with impervious material to prevent the leachate from contaminating groundwater

A well designed and laid out leachate collection mechanism is to be provided

Leachate so collected is treated and then disposed off

9. Energy recovery

10. Sanitary landfill and Onsite sanitation

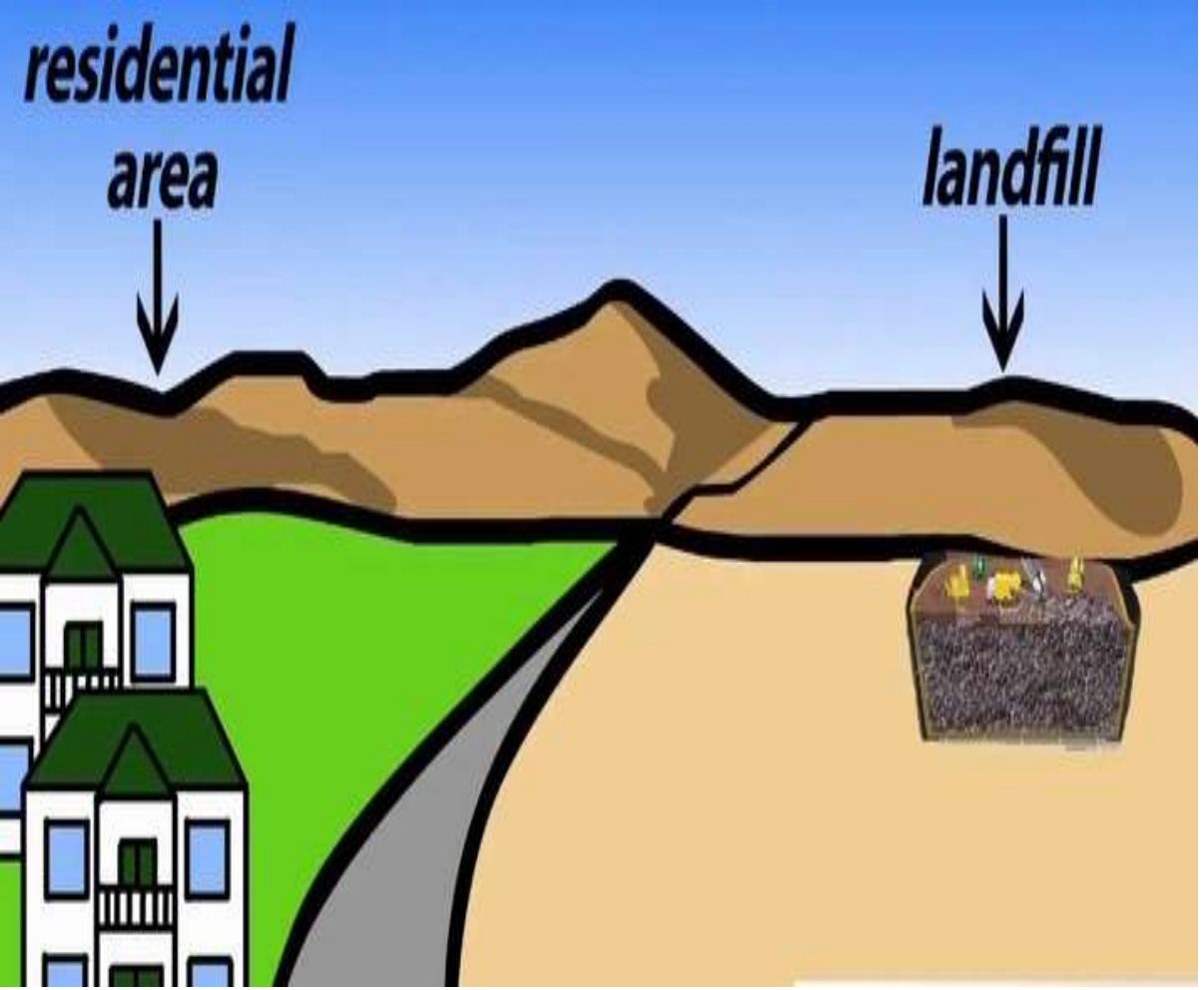
4.2 Sanitary Land Filling

In this method of disposal refuse is carried and dumped into the low lying area as not to cause any nuisance or hazards to public health or safety. The refuse is dumped into the low lying area under an engineered operation, designed and operated according to acceptable standards.

The refuse is dumped and compacted in layers of 0.3 - 0.6m and after the day's work when depth of filling becomes about 1.5m, it is covered by good earth of 15 cm to 30 cm thickness, so that refuse/waste is not exposed directly. The filling is done by dividing the site into smaller portions. The compaction is done by bull dozers, trucks etc. before starting filling the second layer of refuse.

Filling of low lying areas should generally be done by leaving a minimum distance of 6m from the surroundig area. Insecticides like DDT, cresol, creosote etc. should be sprayed on the layers to prevent breeding of mosquitoes and flies. A final cover of about 0.6 m of earth is laid and compacted at the top of the filled up land to prevent rodents from burrowing into the refuse.

As the time passes, the filled up refuse will get stabilised due to decomposition of organic matter and subsequent conversion into stable compounds. The land filling



Sanitary Landfill

Onsite sanitation

Onsite sanitation (or on-site sanitation) is defined as "a sanitation system in which excreta and wastewater are collected and stored or treated on the plot where they are generated".[29]:175 The degree of treatment may be variable, from none to advanced. Examples are pit latrines (no treatment) and septic tanks (primary treatment of wastewater). On-site sanitation systems are often connected to fecal sludge management systems where the fecal sludge that is generated onsite is treated at an offsite location. Wastewater (sewage) is only generated when piped water supply is available within the buildings or close to them.

A related term is a decentralized wastewater system which refers in particular to the wastewater part of on-site sanitation. Similarly, an onsite sewage facility can treat the wastewater generated locally.

On-site Sanitation and Groundwater Contamination: A Policy and Technical Review

Progress of a country must not be directly proportional to the generation of waste. It is a duty of us being an engineer to save earth along with !!

Thank You

Air and Noise Pollution

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TOPICS

- Pollution
- Air & Noise Pollution
- Primary and Secondary Air pollutants
- Harmful effects of Air Pollution
- Control Measures of Air Pollution
- Noise Pollution
- Harmful Effects of noise pollution
- Control measures of noise pollution
- Global warming& Climate Change
- Ozone depletion
- Green House effect

Types of Pollution

- Air Pollution
- Water pollution
- Noise Pollution
- Ground pollution

Air Pollution

Air Pollution and its pollutants

•Air plays a vital role not only in nature but also in the lives of human beings and all living organisms; around 18,000 distinct species need air.

•Living organisms can survive without water for some time but cannot survive without air because when we breathe then we intake oxygen from air and releases carbon dioxide, if this procedure does not take place then it is difficult to survive.

•Due to activities of human beings contaminants are added to air and this is known as air pollution.

•Air pollution occur due to man-made emissions (anthropogenic) emissions into air because emissions made by man change the natural atmosphere's chemical composition.

•Enhancement in global concentrations of gasses of greenhouse like carbon dioxide, methane, nitrous oxide is also known as air pollution.

•Sources of Air Pollution

Natural Sources

✓Natural sources of air pollution include dust storms, forest fires, ash from smoking volcanoes, the decay of organic matters and pollen grains floating in the air.

Manmade Sources

✓Population explosion, deforestation, urbanisation and industrialisation are all human causes of air pollution. Their effects can be explained as follows:

- *The burning of fuels like wood, cow dung cakes, coal and kerosene in homes pollute the air.*
- *Exhaust gases emitted by motor vehicles.*
- *Industries pollute the air by releasing various types of substances such as sulphur dioxide, oxides of carbon, nitrogen oxide, chlorine, asbestos dust and cement dust.*
- *Thermal power plants pollute the air by emitting sulphur dioxide and fly-ash.*
- *Nuclear power plants pollute the air by releasing radioactive rays.*
- *The use of fertilisers and pesticides in agriculture pollute the air.*
- *Mining activities release particulate matter into the air and pollutes it.*
- *The cutting of trees and clearing of forests increases the amount of carbon dioxide in the atmosphere and thereby pollutes it.*
- *The use of chlorofluorocarbons in refrigeration, fire extinguishers and aerosol sprayers pollutes the air by depleting the ozone layer.*
- *Smoking pollutes the air by emitting carbon monoxide and nicotine*

Air Pollution and its pollutants

Primary contaminants: These are directly released into air from sources. The important primary contaminants which are hazardous in high amount are as follows:

- *Carbon compounds*
- *Sulfur compounds*
- *Nitrogen compounds*
- *Halogen compounds*
- *Aerosols or particulate matter are divided into following groups depending upon their diameter:*
  - ✓*Inhalable are particles which are less than 100 microns and these particles can comfortably enter via nose and mouth.*
  - ✓*Thoracic are particles which are less than 10 microns and these particles can enter deep in respiratory system.*
  - ✓*Respirable are particles which are less than 4 microns.*

Air Pollution and its pollutants

Secondary contaminants or pollutants: Secondary contaminants or pollutants are not directly released from sources.
But they are formed in atmosphere from primary contaminants and secondary pollutants.

The important secondary contaminants which are hazardous in high amount are as follows:

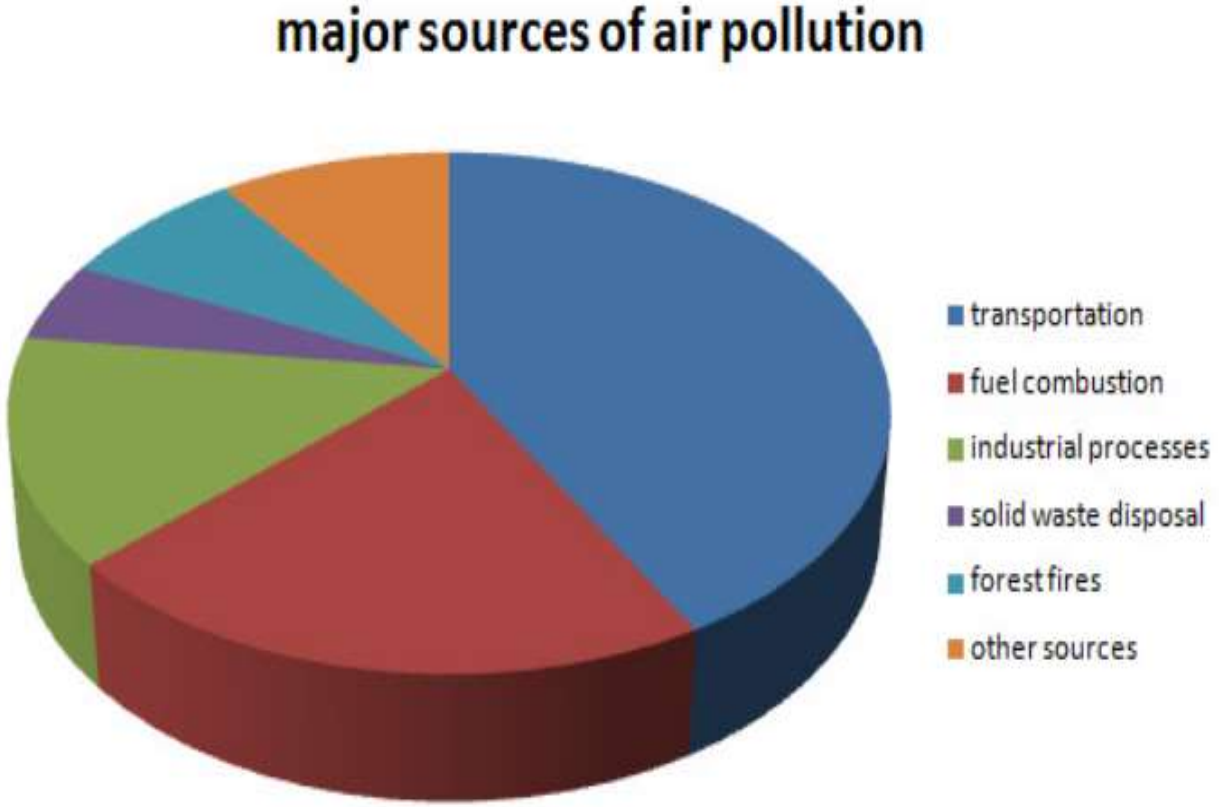
- *Ozone formed from reactions of photochemical of VOCs and nitrogen oxides.*
- *The droplets of sulfuric acid formed from sulfur dioxide.*
- *The droplets of nitric acid formed from nitrogen dioxide.*
- *Sulfate aerosols formed from reactions of sulfuric acid droplets with ammonia.*
- *Nitrate aerosols formed from reactions of nitric acid droplets with ammonia.*

National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual* 24 hours**	50 80	20 80
Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual* 24 hours**	40 80	30 80
Particulate Matter (size less than 10 µm) or PM_{10} $\mu g/m^3$	Annual* 24 hours**	60 100	60 100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$ $\mu g/m^3$	Annual* 24 hours**	40 60	40 60
Ozone (O_3) $\mu g/m^3$	8 hours* 1 hour**	100 180	100 180
Lead (Pb) $\mu g/m^3$	Annual* 24 hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) mg/m^3	8 hours* 1 hour**	02 04	02 04
Ammonia (NH_3) $\mu g/m^3$	Annual* 24 hours**	100 400	100 400
Benzene (C_6H_6) $\mu g/m^3$	Annual*	5	5
Benzo(a)Pyrene (BaP)-particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	60
Nickel (Ni), ng/m^3	Annual*	20	20

Source: 2017 , http://www.indiaenvironmentportal.org.in

AIR QUALITY INDEX https://app.cpcbccr.com/AQI_India/



Particulate matter is the sum of all solid and liquid particles suspended in air many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets. These particles vary greatly in size, composition, and origin.

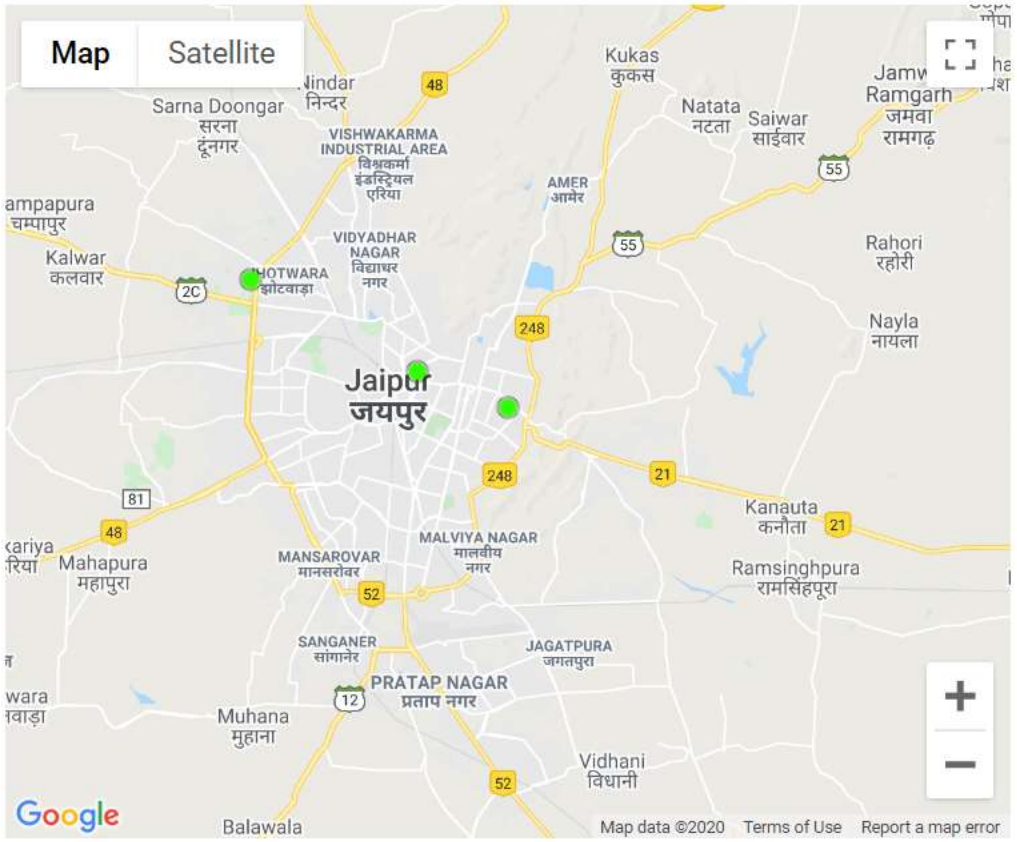
https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

app.cpcbccr.com/AQI_India/

National Air Quality Index

Central Pollution Control Board,
Ministry of Environment, Forests and Climate Change

State: Rajasthan | City: Jaipur | Station: Adarsh Nagar, Jaipur - RSPCB | 10/04/2020 | 0:00



Satisfactory

Adarsh Nagar, Jaipur - RSPCB

Prominent Pollutant is **OZONE**

On **Friday, 10 Apr 2020 12:00 AM**

Pollutant	Timeline	Avg	Min	Max
PM2.5		31	17	63
PM10		49	35	65
NO2		14	8	28
NH3		4	3	7
SO2		14	4	24
CO		44	14	58
OZONE		59	49	78

2AM, Thu | 6AM, Thu | 10AM, Thu | 2PM, Thu | 6PM, Thu | 10PM, Thu

AQI	Remark	Color Code	Possible Health Impacts

List of AQI Stations with Data of above selected Date & Time

•Harmful effects of Air Pollution and Control Measures of Air Pollution

General Control measures

❖Efficiently designed equipment and smokeless fuels should be used in homes and industries.
❖Renewable and non-polluting sources of energy like solar energy, wind energy, etc. should be used.
❖Automobiles should be properly maintained and adhere to emission control standards.
❖More trees should be planted along roadsides and house.

❖Use public transportation, bike, or walk whenever possible.
❖Keep vehicles properly tuned.
❖Use environmentally safe paints and cleaning products whenever possible.
❖Reduce the number of trips you take in your car.

❖Reduce or eliminate fireplace and wood stove use.
❖Avoid burning leaves, trash, and other materials.
❖Avoid using gas-powered lawn and garden equipment Tall chimneys should be installed in factories.
❖Conserve energy - at home, at work, everywhere.
❖Look for the ENERGY STAR label when buying home or office equipment.

•Harmful effects of Air Pollution and Control Measures of Air Pollution

Harmful effects

❖**On Health**

- ✓Irritation of eyes
- ✓Irritation of throat and nose
- ✓Wheezing
- ✓Coughing
- ✓Tightness of chest
- ✓Difficulty in breathing
- ✓Heart problems and lung difficulties like asthma
- ✓Enhanced risk of heart attacks.

❖**On environment**

- ✓Acid rain
- ✓Effect on wildlife
- ✓Depletion of ozone
- ✓Damage to crop
- ✓Damage to forest
- ✓Change of global climate

Methods of Controlling Particulate Emissions

The air pollution caused by particulate matter like dust, ash, etc. can be controlled by using fabric filters, wet scrubbers, electrostatic precipitators and certain mechanical devices.

Mechanical devices work in the following ways:

Fabric filters work by passing the particulate matter through a porous medium made of woven or filled fabrics. The particulates present in the polluted air are filtered and get collected in the fabric filters, while the gases are discharged. The process of controlling air pollution by using fabric filters is called 'bag filtration'.

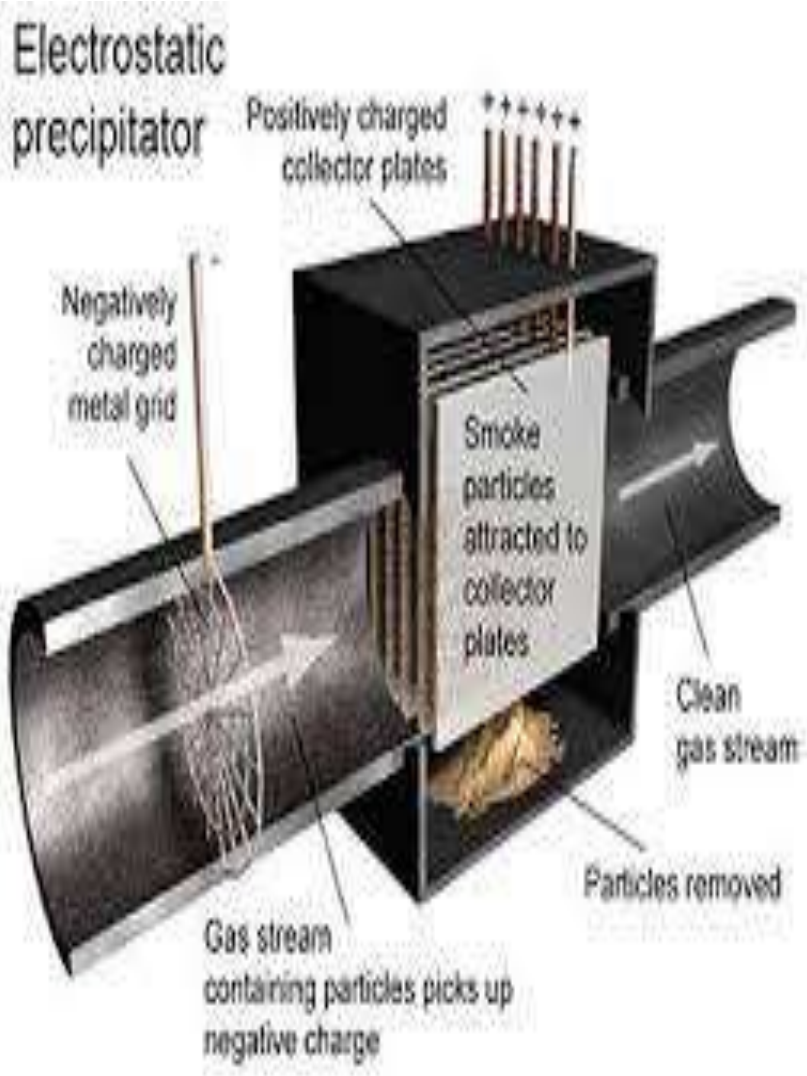
Wet scrubbers are used to trap SO_2, NH_3 and metal fumes by passing the fumes through water.

Electrostatic precipitators induce an electric charge on particles when polluted air containing particulate pollutants is passed through them. Then the aerosol particles (such as smoke) are attracted to oppositely charged electrodes, and they get precipitated from the air.

Methods of Controlling Particulate Emissions

Fabric filters

Wet scrubbers



Electrostatic precipitators


NOISE POLLUTION
HONK
HONK
HONK
HONK
HONK

•Noise Pollution and Harmful Effects of noise pollution

Noise pollution - unwanted or excessive sound that can have deleterious effects on human health and environmental quality.

Causes Of Noise Pollution

- ❑Industrialization
- ❑Poor Urban Planning
- ❑Social Events
- ❑Transportation
- ❑Construction Activities
- ❑Household Chores

Measuring And Perceiving Loudness

Sound waves are vibrations of air molecules carried from a noise source to the ear. Sound is typically described in terms of the loudness (amplitude) and the pitch (frequency) of the wave.

Loudness (also called sound pressure level, or SPL) is measured in logarithmic units called decibels (dB). The normal human ear can detect sounds that range between 0 dB (hearing threshold) and about 140 dB, with sounds between 120dB and 140 dB causing pain (pain threshold).

The ambient SPL in a library is about 35 dB, while that inside a moving bus or subway train is roughly 85 dB; building construction activities can generate SPLs as high as 105 dB at the source. SPLs decrease with distance from the source.

•Harmful Effects of noise pollution and controlling measures

- ❑Hearing problems- Constant exposure to loud noises can damage ear drums and loss of hearing. It also reduces sensitivity of ear drums to pick up small sounds
- ❑Health Issues
- ❑Sleeping disorder- hamper sleeping pattern
- ❑Cardiovascular Issues- issues - t can increase blood pressure, heart beat, headache
- ❑Trouble Communicating- Interference or disturbance in conversions and it can create misunderstanding
- ❑ Effect on Wildlife- It affects not only on humans but also on pets. They can behave more aggressively if exposed to loud noises for longer duration

•Harmful Effects of noise pollution and controlling measures

controlling measures

Turn off Appliances at Home and offices

We can turn off home and office appliances when not in use such as TV, games, computers etc. it can create unnecessary stress on ears. We can save electricity also when we turn them off.

Shut the Door when using noisy Machines

We can shut the door after we turn on dishwashers or washing machines for rooms where it is kept or we can turn them on before leaving house so that overlapping of exposure to loud noises can be reduced.

Use Earplugs

Use of earplugs or earmuffs can bring down loud noises to manageable level. Earplugs are small inserts that fit into out ear canal. And earmuffs fit over the entire outer ear to form an air seal keeping ears safe from loud noises.

Lower the volume

We can listen songs, radios, TVs in lower volume when listening from headphones or speakers.

Stay away from Noisy area

Noise producing industries, airports, vehicles should be far from residential areas as it very dangerous for infants and senior citizens.

Follow the Limits of Noise level

Community law should check use of loudspeakers, outdoor parties as well as political public announcements.

•Harmful Effects of noise pollution and controlling measures

controlling measures

Control Noise level near sensitive areas
There should be control on noise level (Silent zones) near schools, hospitals. Place noise limits boards near sensitive areas.
Go Green by planning trees
We can plant more trees as they are good noise absorbents. According to studies it can reduce noise by 5 to 10 decibels Db around them.

Create Healthy noise to eliminate unwanted noise
If we can't eliminate unwanted noise coming from outside then we can create healthier noise such as music, singing birds or waterfalls in homes or offices.
Use Noise absorbents in noisy machineries
We can check for machineries which are creating noise due to vibrations and put some noise absorbents to reduce noise.

Use Proper Lubrication and Better maintenance
We can use proper lubrication as well as better maintenance of machines to reduce noise pollution and improve efficiency. It reduces friction between movable parts and helps to reduce noise.
Notify Authorities about Disobedience of Noise Rules
We can notify to government agencies if someone is not following rules and regulation regarding noise levels.
Regularly check noise levels
Regularly checking noise level in industrial complex and indoor to keep noise level within limit.

•Global warming & Climate Change

Global warming, the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries. Climate scientists have since the mid-20th century gathered detailed observations of various weather phenomena (such as temperatures, precipitation, and storms) and of related influences on climate (such as ocean currents and the atmosphere's chemical composition). These data indicate that Earth's climate has changed over almost every conceivable timescale since the beginning of geologic time and that the influence of human activities since at least the beginning of the Industrial Revolution has been deeply woven into the very fabric of climate change.

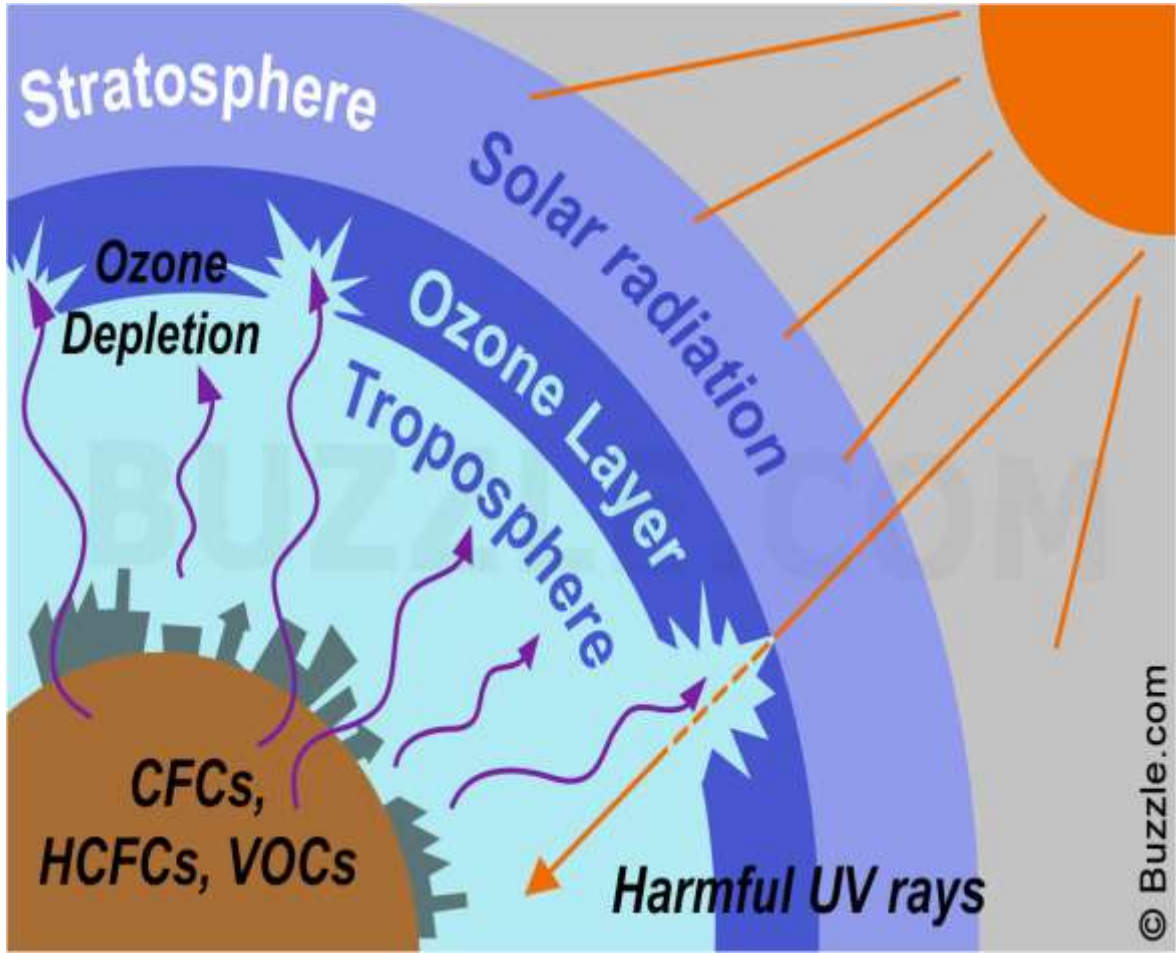
Giving voice to a growing conviction of most of the scientific community, the Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP). In 2013 the IPCC reported that the interval between 1880 and 2012 saw an increase in global average surface temperature of approximately 0.9 °C (1.5 °F). The increase is closer to 1.1 °C (2.0 °F) when measured relative to the preindustrial (i.e., 1750–1800) mean temperature.

Climate change, periodic modification of Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth system.

Ozone depletion

Ozone depletion, gradual thinning of Earth's ozone layer in the upper atmosphere caused by the release of chemical compounds containing gaseous chlorine or bromine from industry and other human activities. The thinning is most pronounced in the polar regions, especially over Antarctica. Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage.

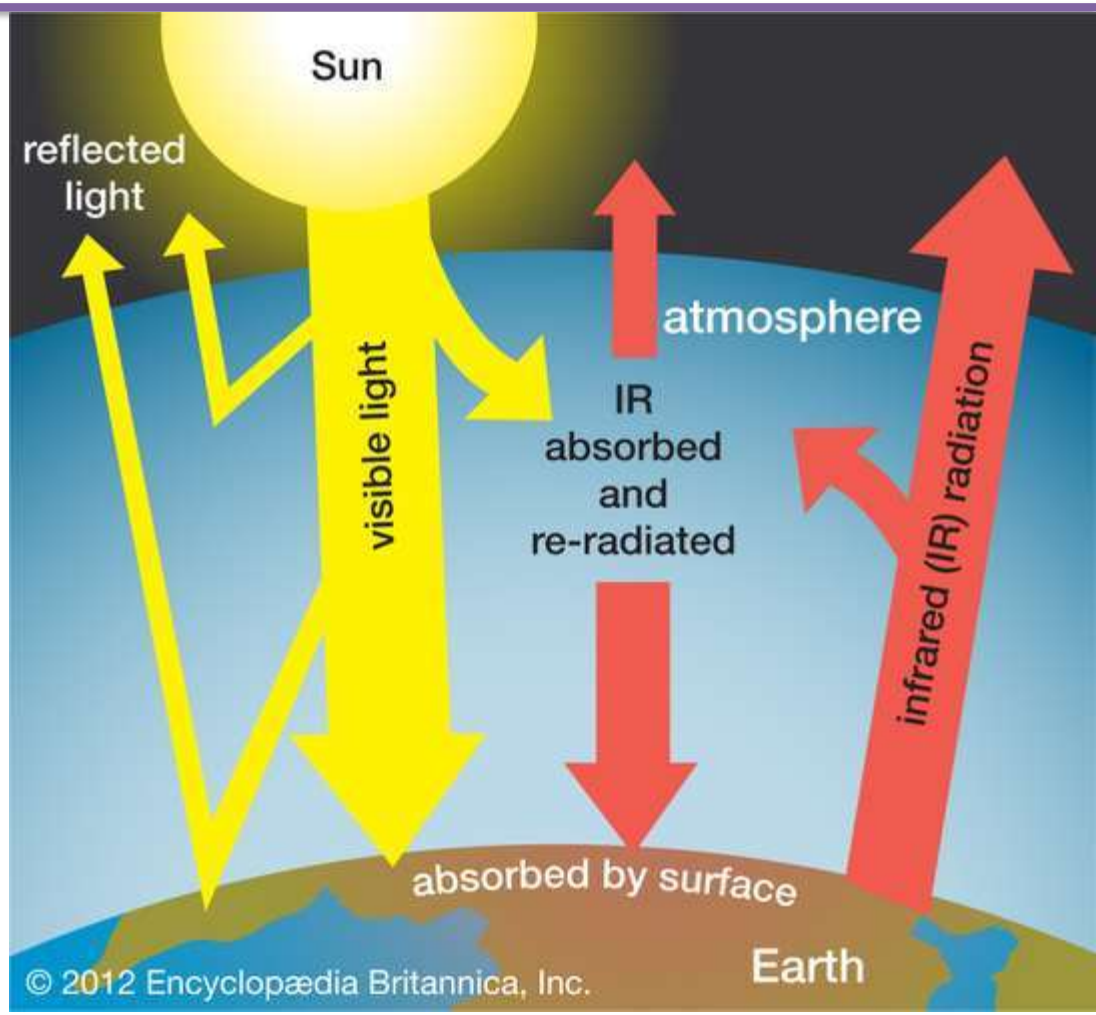
This global decrease in stratospheric ozone is well correlated with rising levels of chlorine and bromine in the stratosphere from the manufacture and release of CFCs and other halocarbons. Halocarbons are produced by industry for a variety of uses, such as refrigerants (in refrigerators, air conditioners, and large chillers), propellants for aerosol cans, blowing agents for making plastic foams, firefighting agents, and solvents for dry cleaning and degreasing. Atmospheric measurements have clearly corroborated theoretical studies showing that chlorine and bromine released from halocarbons in the stratosphere react with and destroy ozone.



•Green House effect

Greenhouse effect, a warming of Earth's surface and troposphere (the lowest layer of the atmosphere) caused by the presence of water vapour, carbon dioxide, methane, and certain other gases in the air. Of those gases, known as greenhouse gases, water vapour has the largest effect. Arrhenius first refers to this "hot-house theory" of the atmosphere—which would be known later as the greenhouse effect—in his work *Worlds in the Making* (1903).

The atmosphere allows most of the visible light from the Sun to pass through and reach Earth's surface. As Earth's surface is heated by sunlight, it radiates part of this energy back toward space as infrared radiation. This radiation, unlike visible light, tends to be absorbed by the greenhouse gases in the atmosphere, raising its temperature. The heated atmosphere in turn radiates infrared radiation back toward Earth's surface. (Despite its name, the greenhouse effect is different from the warming in a greenhouse, where panes of glass transmit visible sunlight but hold heat inside the building by trapping warmed air.)



THANK YOU