Bachelor of Business Administration (BBA)

Environmental Impact Analysis (DBBAAE101T24)

Self-Learning Material (SEM 1)

Jaipur National University
Centre for Distance and Online Education

Established by Government of Rajasthan
Approved by UGC under Sec 2(f) of UGC ACT 1956
&
NAAC A+ Accredited

Table of Contents

Unit	Title	Page No.
Unit 1	Ecosystem	01-16
Unit 2	Biodiversity	17-27
Unit 3	Water Pollution	28-37
Unit 4	Air Pollution	38-48
Unit 5	Noise Pollution	49-57
Unit 6	Solid Waste Management	58-66

Expert Committee

Prof. R.L. Raina
Former Vice Chancellor, JKLU
Professor of Communication, IIM Lucknow

Prof. Divya Srivastava
Dean and Director,
Jaipur National University, Jaipur

Course Coordinator

Ms. Shruti Agarwal
Department of Business & Management, JNU

Unit Preparation

Unit Writers

Mr. Vivek Khambra
Department of Business & Management, JNU, Jaipur
(Unit 1-2)

Dr. Juhi Sharma
Department of Life Sciences, JNU, Jaipur
(Unit 3-6)

Assisting & Proof Reading

Ms. Kratika Pathak
Department of Life Sciences, JNU, Jaipur

Editor

Dr. Sunita Rao, JNU, Jaipur

Secretarial Assistance

Mr. Nitin Parashar

Course Introduction

Environmental Impact Analysis is assigned 2 credits and 6 units. Environmental studies emerged as a distinct field of study in the mid-20th century, because of the growing awareness and concern about the environmental impacts and challenges of human activities, such as industrialization, urbanization, population growth, and consumption.

The scope of environmental studies in India is vast and diverse, encompassing a wide range of fields and disciplines. Environmental studies in India focus on understanding the complex relationships between human and natural systems, and addressing the various environmental challenges facing the country, such as climate change, deforestation, air and water pollution, and biodiversity loss. The field includes research and analysis of environmental policies and regulations, environmental impact assessments, sustainable development practices, and conservation efforts. Furthermore, environmental studies in India aim to raise public awareness and education about environmental issues, and to develop innovative solutions to ensure a sustainable future for the country.

Each unit is divided into sections and sub-sections. Each unit begins with statement of objectives to indicate what we expect you to achieve through the unit.

Course Outcomes-

After studying this course, a student will be able to –

1. Recall the basics of Environmental Management, its concepts and principles
2. Review the Energy sector and its management in current scenario.
3. Determine the environmental issues, ethics and management system.
4. Analyze the environment needs, problems and develop sustainable development
5. Assess the environmental protection laws and review the UN Convention on Biodiversity.
6. Develop a desired course of action for optimal utilization of scarce environmental resources within legal framework.

Acknowledgement

The content we have utilized is solely educational in nature. The copyright proprietors of the materials reproduced in this book have been tracked down as much as possible. The editors apologize for any violation that may have happened, and they will be happy to rectify any such material in later versions of this book.

Unit 1

Ecosystem

Learning Objectives:

1. Understand the Ecosystem
2. Learn about its Structure & Functions
3. Get known important terms
4. Understand their meanings with examples

Structure:

1.1 Ecosystem: An Introduction

1.2 Structure and Functions of Ecosystem

1.3 Food Chain

1.4 Food Web

1.5 Ecological Pyramid

1.6 Biogeochemical Cycles

1.7 Summary

1.8 Keywords

1.9 Self-Assessment Questions

1.10 Case Study

1.11 References

1.1 Ecosystem: An Introduction

In ecology, an ecosystem is a structural and functional unit in which living things interact with one another and their immediate surroundings. In simpler terms, it is a series of interactions between the species and their surroundings. A.G. Tansley, an English botanist, first coined and used the word "Ecosystem" in 1935.

The study of ecosystems focuses on how species that coexist with one another interact and how energy moves through the web of organisms in an ecosystem. It also examines how an organism interacts with others to live sustainably, harming or benefiting those involved. Nature demonstrates that ecosystems can be massive or small, depending on how many abiotic elements are in the surrounding environment. Due to the harsh climate in the north and south poles, the ecosystems do not have as much flora and fauna as those with a tropical climate, such as a forest. Thus, only those species that can survive in such a setting will be able to contribute to the ecosystem. A biosphere consists of various ecosystems working together.

A significant example of an ecosystem is a pond. Ecosystems can be found in ponds, lakes, deserts, grasslands, meadows, forests, etc.

1.1.1 Two Components of the Ecosystem

1. Biotic Components
2. Abiotic Components

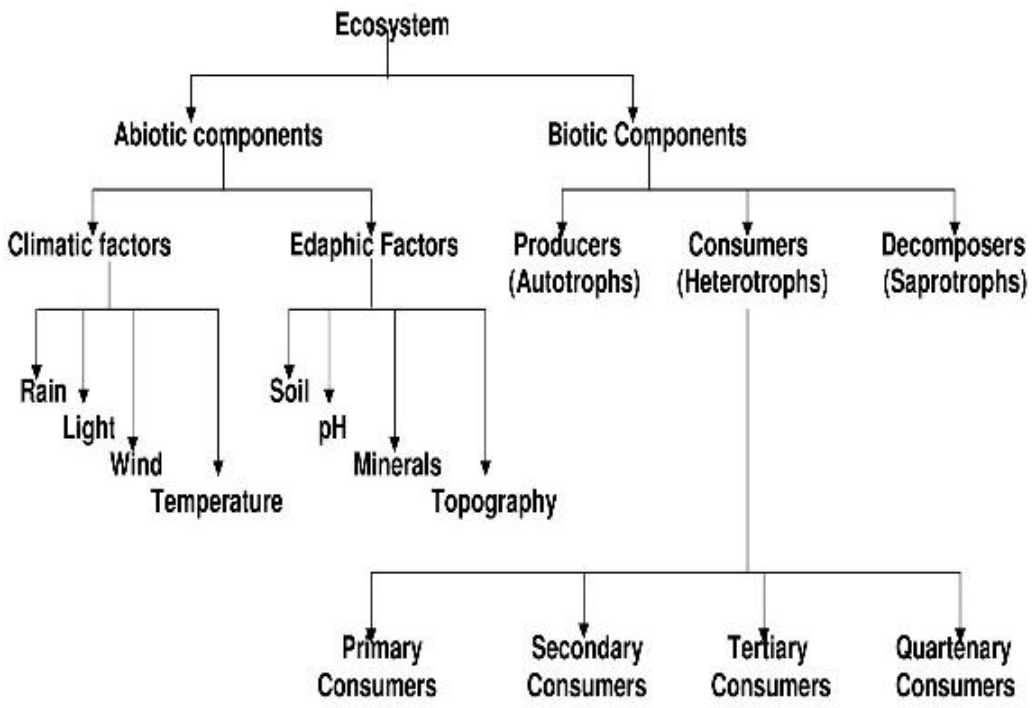

Figure 1.1: Components of the Ecosystem

Source: EDUINDEX NEWS

- **Abiotic factors** are nonliving elements of the environment that impact how living things interact. They consist of the following:
  Physical Environment: The ecosystem's surrounding conditions, including soil type, topographical characteristics, water availability, temperature, humidity, and sunlight.

- **Biotic elements** are the ecosystem's living creatures. They can be divided further into three major categories:

1. Producers: Through photosynthesis, plants, algae, and some microorganisms can create their food.
2. Consumers: Animals and other species that get energy from eating other organisms are considered consumers. These are further classified into the following categories:
    - Primary Consumers: These creatures eat straight from the producers. They are herbivorous creatures like giraffes, deer, rabbits, cows, and buffalo.

- Secondary Consumers: These creatures obtain their sustenance from the primary consumers. These creatures include omnivorous and carnivorous species, including dogs, cats, snakes, and crows.
- Tertiary Consumers: These creatures eat secondary consumers. These are the only carnivores which only eat meat and typically hunt their prey, such as a lion, tiger, or cheetah.
- Quaternary Consumers: These organisms obtain their sustenance from tertiary consumers. For instance, an eagle may eat a snake that consumes a frog, which eats a fly.

3. Decomposers: Bacteria, fungi, and other creatures that disintegrate decaying organic materials and replenish the ecosystem with nutrients.

Figure 1.1 demonstrates the interconnectivity of these elements within an ecosystem. The energy from the sun is transformed or converted into food by producers, which consumers eat subsequently. Decomposers disintegrate the remains of deceased creatures, supplying the ecology with nutrients. All living things can access the materials and factors they need from their physical surroundings.

Understanding that different habitat types, such as forests, grasslands, oceans, or deserts, might have very different ecosystems is essential. Although each ecosystem has its specific mix of parts and interactions, the above flowchart captures the essential elements common to most ecosystems.

1.2 Structure & Functions of Ecosystem

The ecosystem serves the following purposes:

1. It maintains stability, supports living systems, and controls crucial ecological processes.
2. Additionally, it is in charge of how nutrients are transferred between biotic and abiotic elements.
3. It keeps the ecosystem's various trophic levels in a state of equilibrium.
4. The minerals are circulated throughout the ecosystem.

5. The synthesis of organic components, which involves energy exchange, is assisted by the abiotic components.
6. Consequently, the functional elements or ecosystem's functional units are as follows:
    - Productivity: The rate at which biomass is produced is productivity.
    - Energy flow: It is the method by which energy moves systematically from one trophic level to another. The sun's energy passes from solar energy producers to consumers to decomposers and ultimately returns to the environment.
    - Decomposition: It is the process by which dead organic matter is broken down. The topsoil is where most degradation occurs.
    - Nutrient cycling: In an ecosystem, nutrients are used by one organism and then recycled in various ways for utilisation by another.

These functions are further explained for a better understanding.

1. Productivity:

An ecosystem's gross primary productivity (GPP) measures how quickly organic matter is produced during photosynthesis.GPP has a crucial role in plant respiration. The Net primary productivity (NPP) is calculated as gross primary productivity minus respiration losses (R).

The biomass available for consumption by heterotrophs (herbivores and decomposers) is GPP - R = NPP. Moreover, secondary productivity is the rate at which consumers create new organic matter.

2. Energy Flow

Energy flow and food chains are two features of ecosystems that make them dynamic as they link an ecosystem's biotic and abiotic elements. The Sun is the only energy source for all ecosystems on Earth, except the marine hydrothermal ecology, and less than 50% of the incident solar radiation is PAR (photosynthetically active radiation). Just 2-10% of PAR is absorbed by plants, but this little energy is enough to sustain all life on Earth.

All species depend on farmers for food, either directly or indirectly. Energy, therefore, travels singly from the sun through producers to consumers.

Ecosystems require a consistent energy source to synthesise the chemicals they need to fight the general trend towards growing disorderliness.

An ecosystem has a linear or one-way flow of energy.

The size of the boxes in Figure 1.2 demonstrates how less energy moves through the various trophic stages as time goes on. Each organism in a food chain or web uses the energy it receives at that point to support itself.

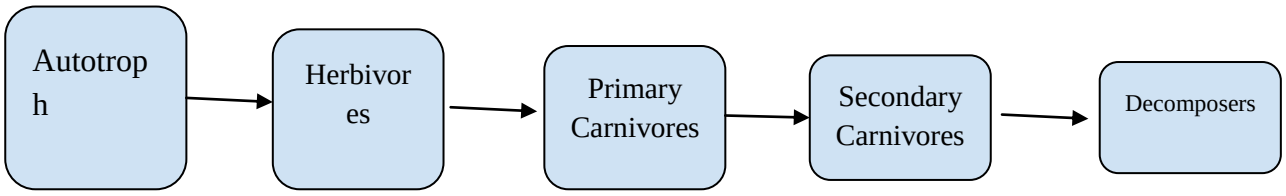

Figure 1.2: Energy Flow in an Ecosystem

1.3 Food Chain

The ongoing process of eating and being eaten by various species through a chain of producers (green plants) is called a food chain.

1.3.1 Types of food chains:

1. **Grazing Food Chain:** It begins with green plants that produce food for herbivores, providing food for predators. Only 10% of the energy is transferred from the lower trophic level to each trophic level in the grazing food chain, which is governed by a 10% law.
2. **Detritus Food Chain:** It begins with decaying biological materials. For protozoans, carnivores, and other species, detritivorous organisms produce food.

The energy source for the first-level customers is a significant point of difference between these two food chains.

Living plant biomass is the primary energy source in the grazing food chain, whereas detritus, or dead organic matter, is the primary energy source in the detritus food chain.

The two chains work together to form a y-shaped food chain in an ecosystem.

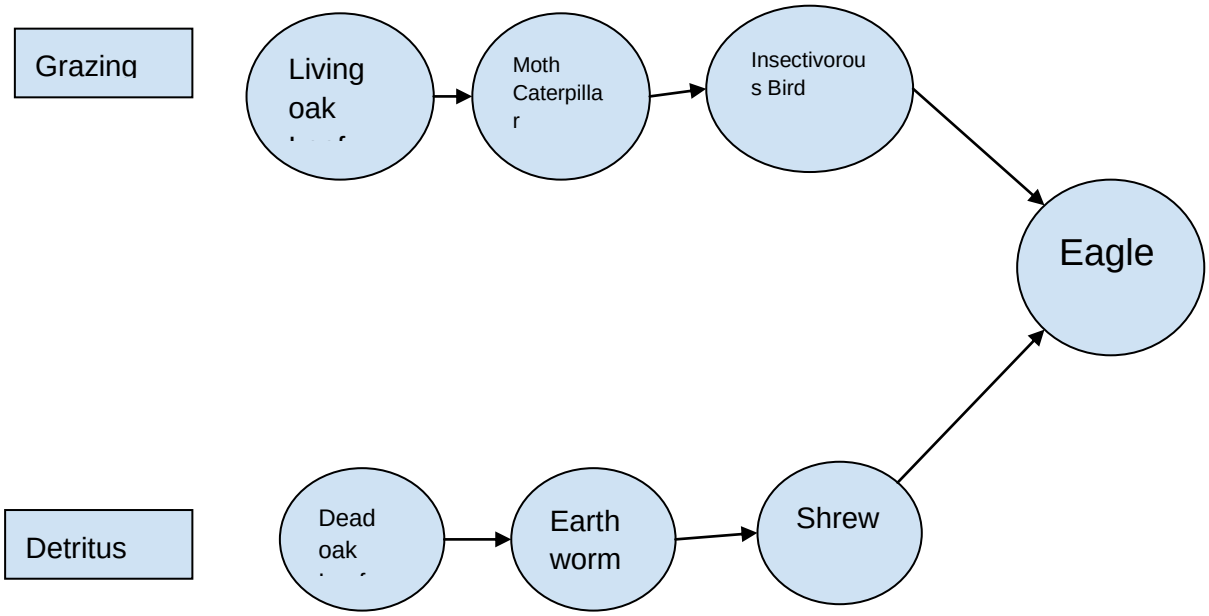

Figure 1.3: Y-shaped Food Chain

Another example of a food chain is mentioned below.

The grasshopper eats the plant, which is eaten by a mouse. The snake then eats a mouse, followed by an eagle. When the eagle dies, its body is broken down into nutrients by fungi. W of sun and water, these nutrients lead to grass growth.

1.4 Food Web

In 1927, Charles Elton introduced the idea of the food web, which he called the "food cycle." According to Charles Elton, a food web is: The herbivores eat plants that get their energy from the sun and are preyed upon by carnivore animals. The latter carnivores may also be preyed upon by other carnivores.

There are chains of animals that are related by food, and all depend on plants in the long run. This is known as a food chain, and all the food chains in a community are known as the food web. Until an animal reaches a stage where it has no enemies, it forms a terminus on this food cycle.

A food web represents relationships between species that make up an ecological community. A particular ecosystem's food chains are included in the food web. They serve as an example of numerous methods of feeding. The food web explains the energy transfer through species in a community.

The relationships between the food chains are interrelated in a natural environment or an ecosystem. These relationships are very complex because one organism may be a part of multiple food chains. All the food chains are interconnected and overlapping within an ecosystem, and they make up a food web.

Every living thing is accountable and is a member of various food chains in the specific ecosystem. Food webs are an integral component of an ecosystem; they allow an organism to get food from multiple kinds of creatures of the lower trophic level.

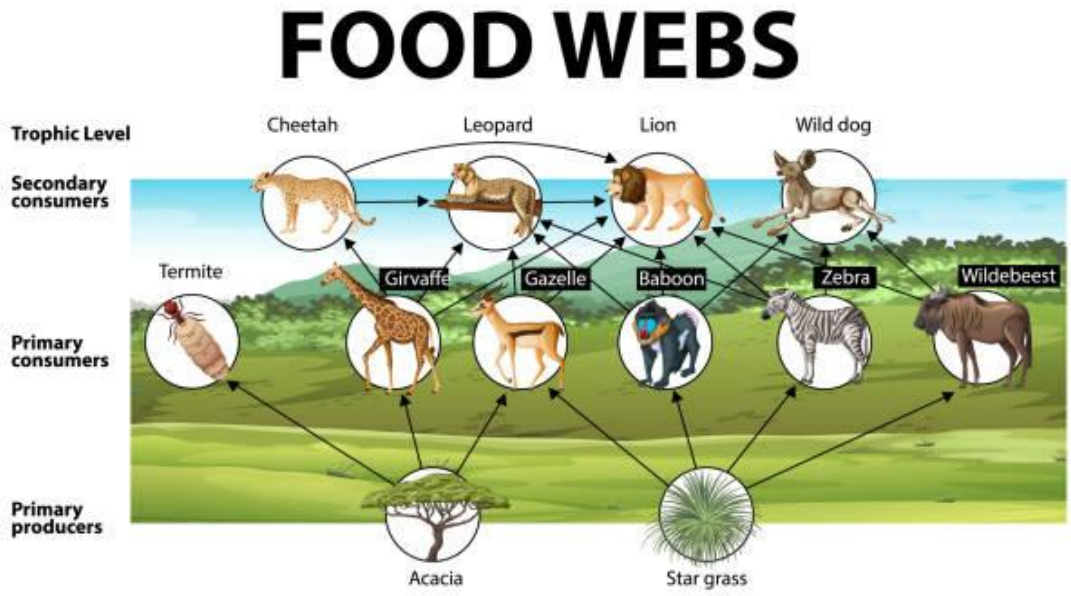

Figure 1.4: Food Web

Source: iStock

1.5 Ecological Pyramid

The ecological pyramid illustrates various creatures' trophic levels based on their roles as producers and consumers. The biomass or bio-productivity at each trophic level is depicted graphically using an ecological pyramid.

The pyramid includes several bars arranged horizontally that present a specific trophic level, with the length of each bar representing the total number of individuals, biomass, or energy at each trophic level in an ecosystem. The food producer is present at the base and top of the pyramid. Other consumer trophic levels are present in between.

The amount of biomass and its distribution among the species at each trophic level is shown by biomass pyramids. The productivity pyramids display biomass output or turnover. Ecological pyramids begin with producers, such as green plants, at the base and progress up through various trophic levels, such as herbivores that eat plants, predators that eat herbivores, carnivores that eat those carnivores, and so on.

The top of the chain displays the highest level. Energy will predictably move through the food chain, entering the base through primary producers' photosynthesis before rising to higher trophic levels.

The quantity of energy entering each trophic level should impact the abundance and biomass of organisms there. Pyramids of biomass and numbers will emerge when there is a direct association between energy, numbers, and biomass.

1.5.1 Types of Pyramids

1. **Pyramid of Numbers**

The total number of people from various species present at each trophic level, also known as the population of the tropical group, is represented by a pyramid of numbers which can be either upright or fully inverted.

The pyramid of numbers only partially defines the trophic structure of an ecosystem because it is challenging to enumerate all the creatures present there. For example, the ecosystem of grassland is upright because the population decreases from a lower level to a higher level. However, the ecosystem of a tree is inverted because the population at each trophic level increases from lower to higher levels.

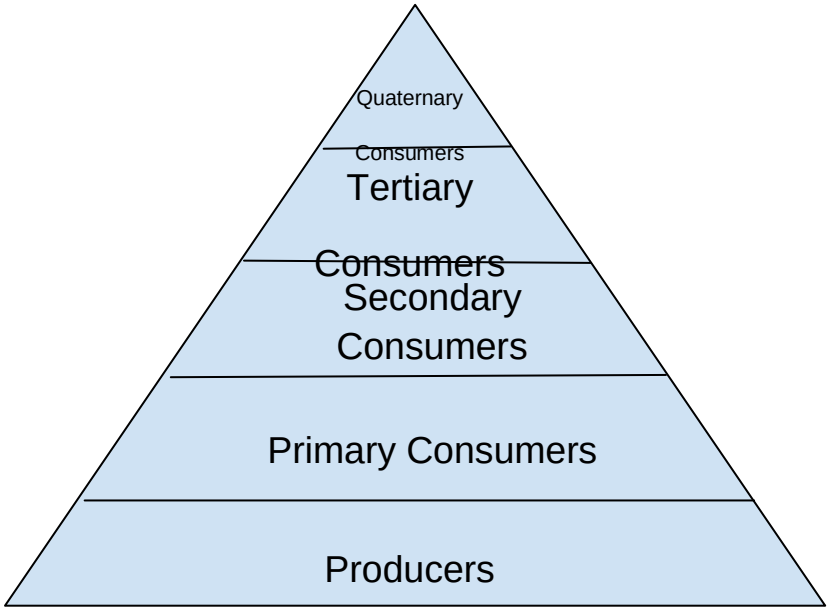

Figure 1.5: Pyramid of Numbers in Grassland Ecosystem

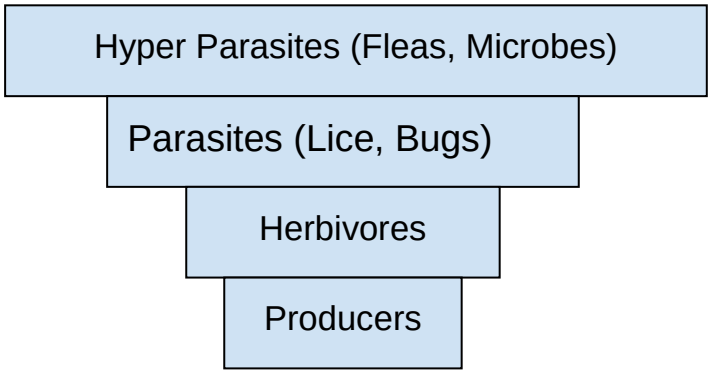

Figure 1.6: Pyramid of Numbers in Tree Ecosystem

2. Pyramid of Biomass

The biomass pyramid represents the dry weight of all creatures. Typically, it is calculated by gathering every organism in each trophic level separately and weighing their dry weight. The unit for measurement of biomass is g/m2. Because primary producers dominate the base of the biomass pyramid on land and a lower trophic level is present at the top, the biomass pyramid is always upright.

The biomass pyramid is present in many aquatic ecosystems in an inverted form. This is because the producers are tiny phytoplankton that quickly develop and reproduce.

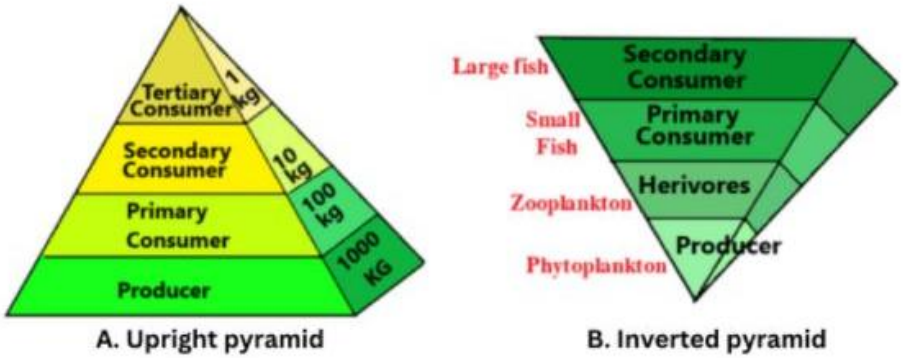

Figure 1.7: Pyramids of Biomass

Source: Science Query

3. Pyramid of Energy

The energy pyramid represents the movement of energy from lower trophic levels to higher trophic levels. During the transfer of power from one creature to another, there is a notable energy loss that takes the form of heat. The primary producers, such as autotrophs, have more energy easily accessible, whereas tertiary consumers have the least. As a result, shorter food chains have more energy availability even at the highest trophic levels.

The amount of energy at each trophic level and the point lost during the transfer to a different trophic level is represented by an energy pyramid.

As a result, the pyramid is always upward and has substantial energy at its base.

1.6 Biogeochemical Cycle

The words ``bio" and "geo" refer to the biosphere, "geochemical" refers to the elements that circulate through a cycle, and "chemical" refers to the geological components. The earth's energy from the sun is radiated back as heat while some substances remain in a closed system. These elements include Carbon, Nitrogen, Hydrogen, Oxygen, Phosphorus, and Sulphur. These, therefore, are recycled by the components of the ecosystem. These cycles provide an example of how energy is utilised. They transport the components needed for life to exist throughout the biosphere. They are essential because they recycle, store, and control vital materials through physical facets. Ecosystems can continue because these cycles show how living and nonliving things interact in ecosystems.

1.6.1 Types of Biogeochemical Cycles

1. Water Cycle

Water from the various bodies evaporates, cools, condenses, and then returns to the ground as rain.

The cycle of biogeochemical processes is in charge of sustaining the weather. Water interacts with the environment and modifies the atmosphere's temperature and pressure in all its forms.

Evapotranspiration, or the vapour produced by leaves, is a different mechanism that helps this one. The water that evaporates from the leaves, soil, and water sources and enters the atmosphere later condenses and falls as rain.

2. Carbon Cycle

The carbon exchange between the biosphere, geosphere, hydrosphere, atmosphere, and pedosphere occurs in the carbon cycle. Photosynthesis occurs when carbon dioxide and sunshine are combined in green plants. Thus, the plant stores carbon. When dead, the green

plants are buried in the soil, which releases carbon to create fossil fuels. These fossil fuels emit carbon dioxide into the earth's atmosphere when burned.

Additionally, animals that eat plants get the carbon that plants store. When these animals decay after they die, the carbon is released back into the atmosphere. The carbon is also released into the environment when animals breathe via their cells. Moreover, Massive amounts of carbon dioxide, which are created, are stored as fossil fuels (coal and oil) and can be retrieved for various commercial and non-commercial uses. The carbon is once more released back into the atmosphere upon combustion when these fuels are used in factories.

3. Nitrogen Cycle

Nitrogen is changed into many forms and circulates through the atmosphere and different ecosystems, including terrestrial and marine ecosystems, through this biogeochemical cycle. This nitrogen gas is transformed into the valuable chemical ammonia by bacteria found in plant roots. Additionally, fertilisers that include ammonia are given to plants. Nitrites and nitrates are produced from this ammonia. Nitrates are converted to nitrogen and released into the atmosphere by denitrifying bacteria.

4. Oxygen Cycle

The lithosphere, the biosphere, and the atmosphere are all involved in this biogeochemical cycle. About 21% of the earth's atmosphere contains oxygen in its elemental form. During photosynthesis, plants emit oxygen. When people and other animals breathe in oxygen, they exhale carbon dioxide, which plants absorb. They use this carbon dioxide during photosynthesis to turn it into oxygen, continuing the cycle.

5. Phosphorus Cycle

Phosphorus travels through the hydrosphere, lithosphere, and biosphere throughout this biogeochemical cycle. The weathering of rocks releases phosphorus. Phosphorus is removed from the soil and water bodies by rain and erosion. To grow and thrive, animals and plants acquire this phosphorus from the soil and water. It is also necessary for the growth of microorganisms. When plants and animals perish, they decompose, returning the stored

phosphorus to the soil and water bodies, where it is once more absorbed by new plants and animals, continuing the cycle.

6. Sulphur Cycle

This biogeochemical cycle passes through living things, water, and rocks. When rock weather, sulphur gets released into the atmosphere and changed into sulphates. The bacteria and plants absorb these sulphates and transform them into organic forms. Animals take in organic sulphur through their diet. The cycle is continued when an animal decomposes, returning sulphur to the soil where plants and bacteria once more consume it.

1.7 Summary

- A.G. Tansley, an English botanist, first coined and used the word "Ecosystem" in 1935.
- The study of ecosystems focuses on how species that coexist with one another interact and how energy moves through the web of organisms in an ecosystem.
- Abiotic factors are non-living components of the environment that impact how living things interact.
- Biotic elements are the ecosystem's living creatures.
- Productivity is the rate at which biomass is produced.
- Energy flow is a method where energy moves systematically from one trophic level to another.
- Decomposition is the process by which dead organic matter is broken down. The topsoil is where most degradation occurs.
- In an ecosystem, nutrients are used by one organism and then recycled in various ways for utilisation by another.
- Living plant biomass is the primary energy source in the grazing food chain, whereas detritus, or dead organic matter, is the primary energy source in the detritus food chain.
- In 1927, Charles Elton introduced the idea of the food web, which he called the "food cycle."

- A food web visually represents the relationships between the species that comprise an ecological community.
- All the food chains are interconnected and overlapping within an ecosystem, and they make up a food web.
- The ecological pyramid illustrates various creatures' trophic levels based on their roles as producers and consumers. The biomass or bio-productivity at each trophic level is depicted graphically using an ecological pyramid.

1.8 Keywords

1. **Ecosystem:** It is a structural and functional unit where living things interact with one another and their surroundings.
2. **Abiotic factors:** These are non-living components of the environment that impact how living things interact.
3. **Biotic elements:** These are the ecosystem's living creatures.
4. **Energy flow**: It is the method by which energy moves systematically from one trophic level to another.
5. **Nutrient cycling:** In an ecosystem, nutrients are used by one organism and then recycled in various ways for utilisation by another.
6. **Food chain:** The ongoing process of eating and being eaten by various species through a chain of producers (green plants) is called a food chain.

1.9 Self-Assessment Questions

1. What does the study of ecosystems primarily focus on?
2. Define abiotic factors in the context of an ecosystem.
3. Describe the process of energy flow in an ecosystem, highlighting its importance.
4. Write a short note on the biogeochemical cycles.
5. Explain the concept of productivity in an ecosystem and its significance.
6. Discuss Charles Elton's contribution to the field of ecology, particularly concerning the concept of the food web.
7. Explain the interconnected nature of food chains within an ecosystem and how they collectively form a food web.

8. Elaborate on the ecological pyramid and how it represents the trophic levels and biomass of organisms in an ecosystem.
9. Compare and contrast the grazing and detritus food chain regarding their primary energy sources and the organisms involved.
10. Who is credited with coining and using the term "Ecosystem" for the first time?

1.10 Case Study

In a forest ecosystem, introducing an invasive species has disrupted the food chain. The dynamics of the food web can be changed by invasive species, which can significantly impact native species and cause ecological imbalances.

Questions:

Based on your understanding of this situation, answer the given questions.

1. What are the invasive species in the forest ecosystem, and what are their characteristics and ecological traits?
2. What are the direct and indirect impacts of the invasive species on different trophic levels in the forest food web?
3. How do human activities contribute to the spread of invasive species, and what are the implications for ecosystem management and conservation?

1.11 References

1. AgarwalShikha, SueshSahu, Environmental Engineering and Disaster Management, DhanpatRai& Co., 2010
2. Brunner R.C., Hazardous Waste Incineration, McGraw Hill Inc. 1989.
3. Cunningham, W.P, Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2001.

Unit: 2

Biodiversity

Learning Objectives:

Know the concept of Biodiversity

Understand the causes of its depletion

Become aware

Learn ways to conserve

Structure:

2.1 Biodiversity and its Values

2.2 Types and Levels of Biodiversity

2.3 Depletion of Biodiversity

2.4 Conservation

2.5 Summary

2.6 Keywords

2.7 Self-Assessment Questions

2.8 Case Study

2.9 References

Biodiversity

2.1 Biodiversity and its Values

The totality of life on earth is called as biodiversity. The biodiversity of Earth includes every human being life form, from the smallest bacteria on Earth's land to the giant whale. Relationships between these lifeforms and their habitat are also part .

Values

The word "biodiversity" is different groups.

deer with tails, fresh flowers, and microscopic microbes and can’t be seen with bare eye.

The following are the categories of biodiversity’s fundamental value:

Ecological Values: By examining the functioning of the ecosystem, it is possible to assess the environmental benefits of biodiversity. Intensive agricultural production ecosystems, for example, provide ecosystem services that support.

It creating , preserving healthy conserving clean groundwater supplies through vegetation, and producing oxygen by plants and microalgae on or beneath the surface.

Consumption-related values: The naturally occurring goods utilised for food, including feed for cattle, wood products, fuelwood, and other things, are consumed daily. Humans, as per research, consume around 40,000 plant and animal types daily. Many people continue to rely on nature for their needs, including food, a temporary place to stay, and clothing.

Productive use values suggest that the goods are sourced and professionally advertised. The crops that we see today are an evolved form of wild varieties. Biotechnologists constantly work with untamed plant species to develop fresh, extra productive and plant varieties that are unaffected by diseases.

2.2 Types and Levels of Biodiversity

Biological diversity broadly describes the transition of life from genes to ecosystems. It includes their existence, genetic variations, environments, populations, and the ecosystems in which they are present, as well as other evolutionary advancements that keep the system functioning, changing, and adapting.

Depending on the degree of variations, biodiversity is divided into many components.

Genetic Diversity: It is the diversity of every species. No two members of the same species are alike. Humans, for instance, exhibit a great deal of biodiversity. There are significant distinctions between inhabitants of different places. Genetic diversity is essential for a population to adjust to changing environmental setting.

Species Diversity: It denotes the variety and abundance of species. A region's species density fluctuates greatly depending on its environmental conditions. For instance, it is frequently seen that a human culture near water sources exhibits more species than elsewhere.

Ecological Diversity: It is the diversity present among an area's ecosystems. Numerous environmental ecosystems, including mangroves, deserts, and rainforests, exhibit a great diversity of living forms inhabiting there.

2.3 Depletion of Biodiversity

The term “Biodiversity loss” refers to the depletion of biodiversity and its elements due to various reasons and mainly human activities.

Figure 2.1: Loss of Biodiversity

Source: IBERDROLA

There are several factors that are responsible for the failure of biodiversity. Such as excessive exploitation of resources, pollution, and changes in the climate brought on by global warming. Humans and their actions play direct roles in each situation.

- Habitat Loss: The diminishing, fragmentation, or total elimination of an ecosystem plant, mud, hydrologic, and nutritive resources is called as a habitat loss.
- Invasive Species: Any non-native variety that considerably alter or disturbs an ecosystems it colonises is consider all-encompassing. Since they pose greater competitors than native species, invasive species have the potential.
- Over use of resources: Excessive use of resources, also called as over hunting and over fishing, is the exercise of taking many water or earthly animals, that cause the depletion of some species' populations and other species to become extinct. Additionally, it indicates that consumption occurs faster than natural regeneration, which affects the planet's vegetation and fauna.
- Pollution: Adding unwanted or detrimental nutrients or compounds to an environment is called pollution.

- Weather fluctuations: These are those which has been primarily caused by individual activity. It may purposely being referred to the warming caused by increased atmospheric level of the greenhouse gases, such as carbon dioxide (CO2), methane (CH4), and few others others. When predictable heat and rainfall pattern are changed due to extra heat being available, the normal cycle of reproduction and resource accessibility are hampered.
- Population: The tropical regions, which comprise only approximately one-fourth of the world's total surface, are home to nearly three-fourths of the world's inhabitants. Half of all species on Earth are found in tropical rainforests. Therefore, One of the reasons that contributes to the hampering of biodiversity, which results in extensive resource utilization and deforestation, is the excess population.
- Other factors: Earth's flora and animals suffer harm from natural disasters such as forest fires, droughts, floods, volcanic eruptions, earthquakes, etc. Pesticides and other contaminants, such as harmful heavy metals and hydrocarbons, wipe out the weak and delicate species.

Figure 2.2 states some more reasons that lead to the overall depletion of biodiversity.

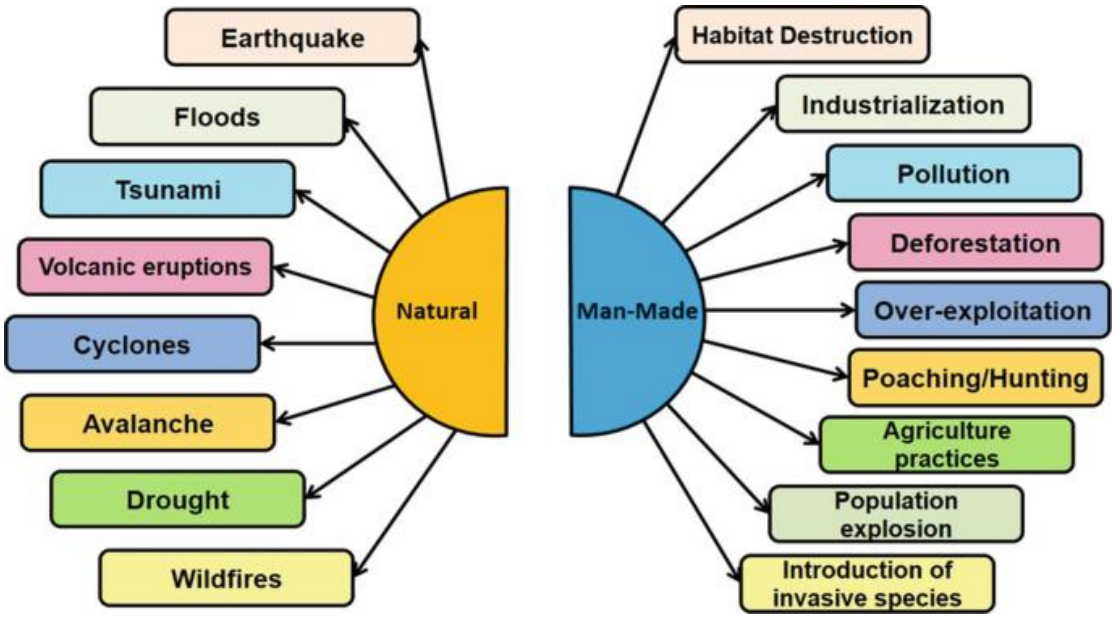

Figure 2.2: Causes of Depletion of Biodiversity

Source: Springer Link

The well-being of the human race will suffer due to biodiversity loss. It will increase the number of animals that spread disease among the local inhabitants. Research has found that the species that are most suited to survive in harshly uneven ecosystems, they are the main active disease vectors.

2.4 Conservation

Biodiversity has to be managed and protected properly in order to acquire the resources for its sustainable development. The region with a high species profusion is likely to have more steady ecosystem than a lesser one. We rely on the plant

species for our various diverse needs. Because of this, we need to conserve biodiversity.

The following are the goals of biodiversity protection:

- To sustain the multiplicity of species.
- Sustainability of use of species and the ecosystem.
  Protection of important ecological process and the various system of supporting life.

2.4.1 Methods of Biodiversity Conservation

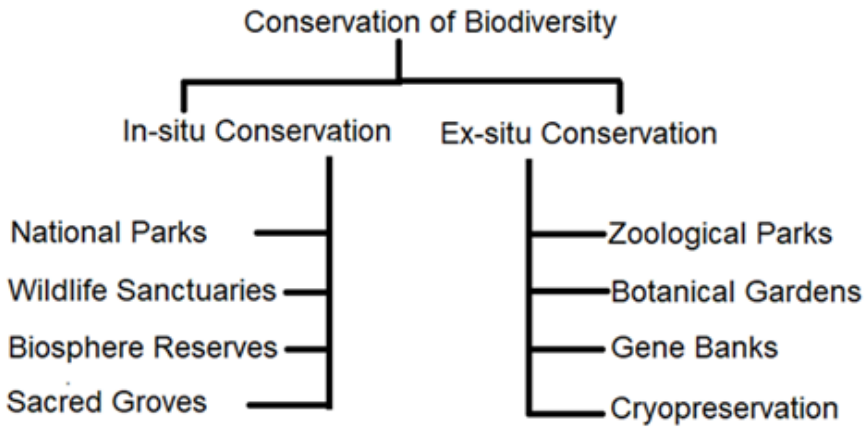

Figure 2.3: Conservation of Biodiversity: Methods

Source: EMBIBE

National parks

To preserve species, the government manages, creates, and protects National Parks, which are small. All human activity is prohibited in these parks.

Wild life

The wild life animals can be found in these wild life sanctuaries. individual activities such as farming, collecting wood and other forest goods are legalized till they don't hamper the conservation initiative. Additionally, tourists take a trip to these regions for recreation and awareness.

Biosphere Reserves

Residents create and maintain biosphere reserves for the sustainable growth and protection of wildlife, flora, and the ecosystem. It comprises both terrestrial and aquatic ecologies. Activities like tourism and research are allowed within these reserves.

Sacred Groves

The entire forest's trees and creatures are revered and granted complete protection by a deity in sacred groves, a specific forest region. They aid in preserving the biodiversity of our nation. No one can harm any living thing in these holy groves since they are self-sustaining mini-ecosystems containing plants and animals. These can be found throughout India. Meghalaya Hills , The Khasi and Jaintia and Aravalli Hills are some of the examples.

2. Ex-Situ Conservation

Reproducing and to maintain rare species in artificial habitat such as nurseries, zoo, , gene banks, botanical gardens etc., is recognized as ex-situ biodiversity conservation. Fewer organisms compete with each other for water, food.

There are several advantages are as follows:-

The animals are given more time and opportunities for reproducing.
It is possible to reintroduce the captive-bred species to the wild.
It is possible to apply genetic approaches to protect threatened species.

Zoological Parks

Animals are relocated from their natural habitat to zoological parks for protection and reproduction. The general public is welcome to go there and witness these animals.

Botanical Gardens

A variety of living plant species are preserved here. It resembles a demonstration garden with a variety of plants. They aid in advocating, researching, and preserving threatened plant species.

Gene Banks

They are organisations that keep inventories of healthy seeds (seed banks), and live plants like orchards

2.4.2 Other Strategies of Conservation

Livestock, agricultural animals, wood plants, and agricultural food product should all be preserved.
Animals that have economic value ought to be protected.
Animals should have access to other habitats.
The overuse of natural resources needs to be avoided.
Hunting and poaching of wild animals ought to be prohibited.
It is necessary to create natural reserves and protected places.
More trees should be planted, and deforestation should be stopped.
Strict legislation should be put into place and adhered to.
Alternative strategies for pollution control should be developed.
It is essential to raise public awareness of the need to protect biodiversity.
Preservation of threatened species in both their natural and artificial habitats should be done to prevent their extinction.

2.5 Summary

The Earth’s Biodiversity has all sort of life’s form, be it the tiny bacteria or the huge whale.
Distinct species of living things reproducing independently is referred to as Biodiversity.

Biological diversity broadly describes the transition of life from genes to ecosystems. It includes their existence, genetic variations, environments, populations, and the ecosystems in which they are present, as well as other evolutionary advancements that keep the system functioning, changing, and adapting.

A region's species density fluctuates greatly depending on its environmental conditions.

We are dependent on a variety of plants for our diverse needs.

2.6 Keywords

1. **Biodiversity:** The word "biodiversity" is often used to denote to “distinct species or groups of independently reproducing living things”.
2. **Genetic Diversity:** It is the diversity that every species member expresses genetically. No two members of the same species are exactly alike.
3. **Species Diversity:** It denotes the variety and abundance of species. A region's species density fluctuates greatly depending on its environmental conditions.
4. **Ecological Diversity:** It is the diversity present among an area's ecosystems. Numerous environmental ecosystems, including mangroves, deserts, and rainforests, exhibit a great diversity of living forms inhabiting there.
5. **Habitat Loss:** “The thinning, fragmentation, or complete elimination of an ecosystem's plant, soil, hydrologic, and nutrient resources is known as habitat loss”.

2.7 Self-Assessment Questions

1. Give points of differences between in-situ and ex-situ conservation of biodiversity?
2. Why is genetic diversity necessary for populations?
3. Explain in detail two examples of in-situ conservation of Biodiversity.
4. As an aware student, what ways would you suggest to conserve the depleting biodiversity?
5. Mention five causes of Biodiversity Loss.
6. Why is it important to conserve biodiversity?
7. How do humans rely on different plant, animal, and microbial species, and why is it crucial to conserve biodiversity to meet our diverse needs?
8. "Genetic diversity is necessary for a population to adjust to shifting environmental conditions". Comment.
9. Are Zoological and National parks the same? Explain their role in the conservation of biodiversity with some examples.
10. Mention some values that biodiversity contributes to.

2.8 Case Study

The fish population has been experiencing a significant decline in the coastal ecosystem. Within the coastal ecosystem, various piscine species exist, which carry out a vital function in perpetuating ecological equilibrium. The decreasing quantity of fish gives rise to apprehensions regarding the well-being and consistency of the environment, including potential consequences for nearby societies reliant on fishing as their means of subsistence.

Questions:

What factors contribute to the decline in fish population in the coastal ecosystem?

What are the potential impacts of the declining fish population on the local communities that rely on fishing?

2.9 References

1. Corporativa, Iberdrola. “Biodiversity Loss, a Risk for the Environment and for Humanity.”
2. “Conservation of Biodiversity- Definition & Methods.” *Embibe Exams*, 25 Jan. 2023.
3. AgarwalShikha, SueshSahu, Environmental Engineering and Disaster Management, DhanpatRai& Co., 2010
4. Brunner R.C., Hazardous Waste Incineration, McGraw Hill Inc. 1989.
5. Cunningham, W.P, Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2001.

Unit: 3

Water Pollution

Learning Objectives:

Learn about water pollution

Understand the pollutants

Get known to its sources

Learn ways to combat

Structure

3.1 Sources of Water

3.2 Water Quality Standard

3.3 Pollutants

3.4 Effects of Water Pollution

3.5 Summary

3.6 Keywords

3.7 Self-Assessment Questions

3.8 Case Study

3.9 References

3.1 Sources of Water

Water is essential to all life and would not exist otherwise.
"sourcewate'' are those that supplies water to the private and public drinking wells.
Surface water and groundwater are the two primary sources of water.

Surface water, groundwater, and rainwater collection other commercial activities. are main sources.

These water sources rely on rainfall and snowfall, both of which are a component of the hydrological cycle. Other sources could be recycled water.

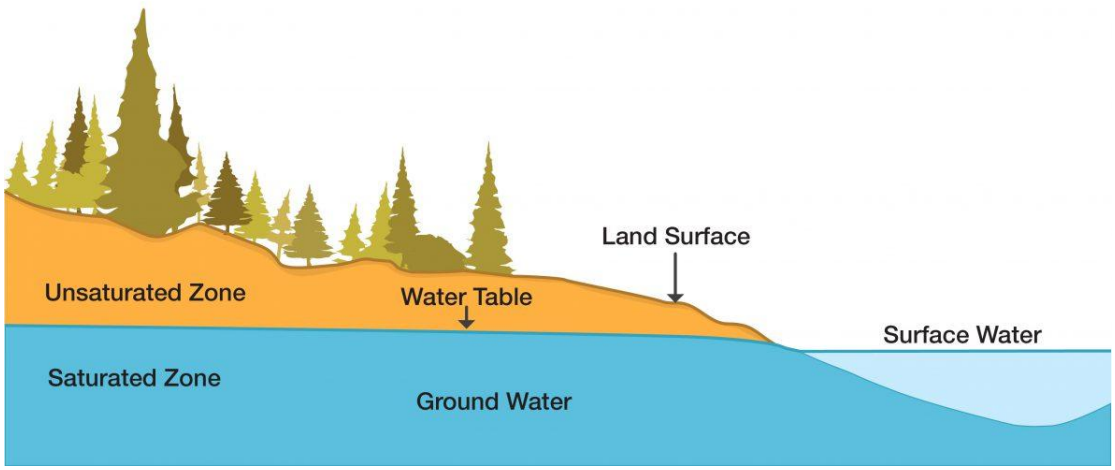

Figure 3.1: Sources of Water

Source: Centre For Disease Control and Prevention

As Figure 3.1 demonstrates

Groundwater filtration may eliminate some pollutants and bacteria according to the water's depth and the location's local geology. Groundwater from a well may go through some level of management before it get to the tap because it is groundwater. The Surface water gets collected in a stream or on the land, lake, river, ocean or reservoir. The stream water of these water bodies continually evaporate seep into the underground water supply, and gets replenish by the rain and the snow.

3.1.2 The Water Cycle

"The contnous moving of water between the seas, the land, and the atmosphere is known as the hydrological or water cycle". Water on the land and in the body of water (oceans, lakes, and rivers) evaporates (turns from a liquid to a vapour) due to sunlight and the wind. Additionally, In the process of transpiration, the plants absorb the liquid water and discharge water vapour through the pore in their leaf. The vapours from water travels above the surface of the earth on increasing air currents in the air. finally, as the vapour to create from water clouds, which then fall back to Earth as rain and snow (collectively, precipitation).

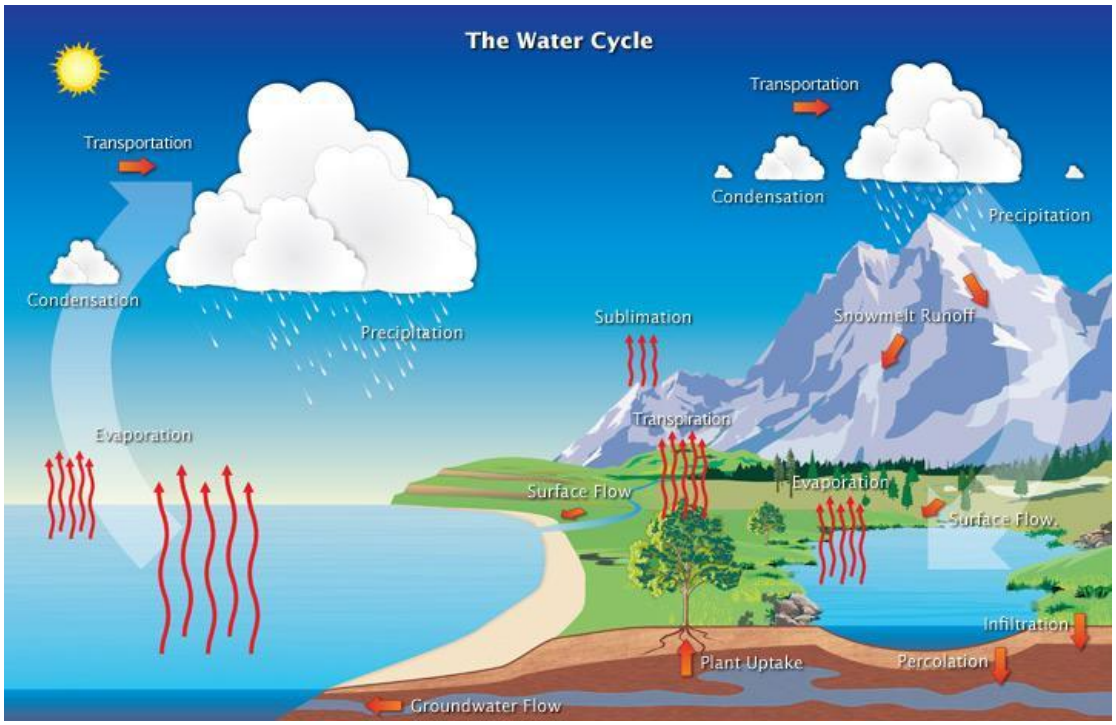

Figure 3.2: Hydrological/Water Cycle

Source: NASA

Reservoirs store water, which is transferred between them during transfer operations. Evaporation and transpiration contribute to the movement

Additionally, water flows across the land, eventually reaching the oceans, completing a continuous cycle of water transfer.

3.2 Water Quality Standards

Access to clean and hygenic drinking water is vital for keeping good health, a basichuman right, and an important part of flourishing health prevention policies. Numerous international policy forums have acknowledged the significance of water, sanitation, and hygiene for health and development.

The World Health Organisation (WHO) has created many normative "guidelines" in response to this, which provide an official assessment of the health risks related to exposure to harmful substances through water and the efficacy of methods for their control. The various recommendations from WHO (promoting the safe utilization of water waste and establishing standards for drinking water quality) are being created independently.

Standards for water quality are made up of three essential parts. To safeguard current uses and high-quality/high-value waters, there are antidegradation regulations and the stated use of the water body.

3.2.1 Water quality standard in India

Ground Water

The deepness of the soils and the underlying geological formation that groundwater is in contact with directly impacts its natural composition of underground water. Most of the country's groundwater is generally acceptable and appropriate for farming, drinking, or industry uses. Most underground water in low aquifers is of mixed and calcium bicarbonate types and is generally suitable for various applications. But there are other kinds of water, too, such as water with sodium chloride. Deeper aquifers' quality varies from location to location and is typically considered acceptable for everyday uses. The coastal tracts are facing salinity issues, and reports of major concentrations of fluoride, iron, and other weighty metals in isolated pockets have been made.

The majority of the dry and semi-arid areas of Rajasthan, Punjab, Gujarat, Uttar Pradesh, Maharashtra , Delhi, Andhra Pradesh, Tamil Nadu and Karnataka are affected by inland saline in groundwater.

Table 3.1: Water Quality Criteria

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 • days 20°C 3mg/l or less
Propagation of Wildlife and Fisheries	D	• pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micromhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l

Source: Central Pollution Control Board

3.3 Pollutants

Water pollutants can be categorized into four groups, which are as follows:

Pathogens
Organic materials
Inorganic compounds
Macroscopic pollutants

1. Pathogens: Pathogens include bacteria, viruses, protozoa, and other microorganisms. For example, bacteria are frequently found in water. However, as the number of bacteria rises, the water might become contaminated. Coliform and E Coli bacteria are the two most harmful bacteria.
2. Organic Materials: Carbon-containing molecules make up organic compounds. Methyl tert-butyl ether (MTBE) is a relatively typical volatile organic compound. MTBE was once employed as an air-cleaning gas additive. Although it was later outlawed, it will take some time for the water to be entirely free of it. Similar to how organic material-containing water can cause lethal illnesses like testicular tumours, leukaemia, kidney and thyroid cancer, lymphoma, and more.
3. Inorganic Materials: While inorganic elements might not be hazardous in modest absorptions, they can become dangerous water pollutants when they mix with other substances in the water. For instance, inorganic materials include heavy metals like copper, arsenic, barium, mercury, zinc, and more.

   Leaching from waste disposal, industrial mishaps, or even increased human activity levels can all contribute to its occurrence. This kind of water contamination also leads to severe health issues in humans and other organisms. Additionally, it can be highly lethal if it is present in larger doses.

4. Macroscopic pollutants: Due to their size and brightness, these kinds of contaminants are particularly noticeable in the water—the most prevalent example of garbage, mainly plastic waste, that finds its way into the sea. Plastic is unlawfully dumped in water because it does not disintegrate. They accumulate in oceans and other bodies of water because they cannot biodegrade.

The following are the leading causes and sources of water pollution:

- Farmers use chemical fertilisers to safeguard pests, other harmful bacteria, that contributes to agriculture related problems
- When a considerable quantity of oil spills into the ocean and fails to disperse, it creates a severe threat to marine life. As a result of this species like birds, fishes, and other sea animals are being affected.
- Industries generates huge amount of garbage that contains toxic.
- Some of the things that pollute the water and aquatic life are: rubber, Paper, plastic, metal, food waste , and glass discarded into the rivers and the sea.

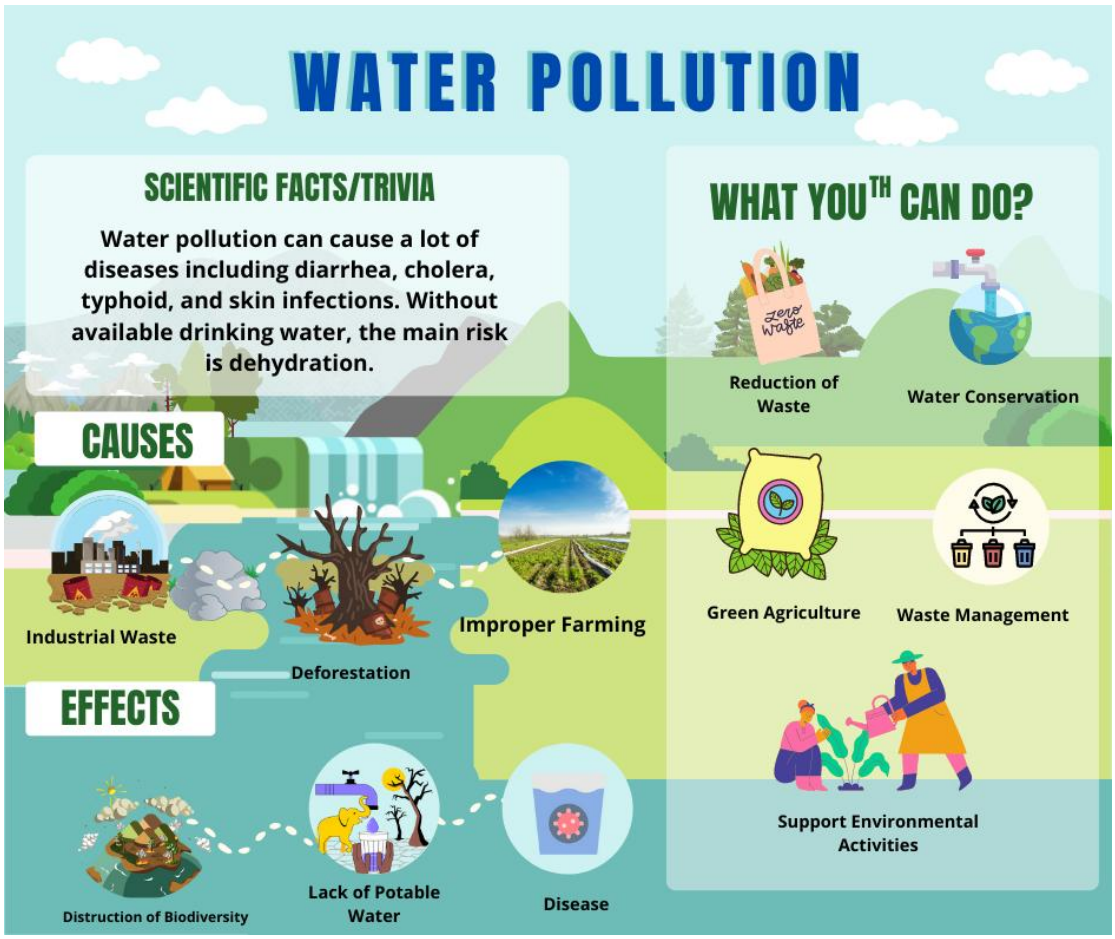

Figure 3.3: Water Pollution

Source: SibolAlaminos

3.4 Effects of Water Pollution

1. Diseases: Polluted water has several terrible impacts on human health, whether consumed through drinking or other means., cholera, hepatitis, and Typhoid and other illness is brought on by it.
2. Destruction of the ecosystem: The Ecosystem incredibly ever changing and react to even minute change in their environment. The entire ecosystem would collapse if the water pollution is not timely controlled.
3. Eutrophication: Algal is formed by chemicals in a body of water. These algai form a layer on top of the pond or lake. Bacteria consumed these algai that lowers the oxygen content and impacts negatively to the acquatic life.

3.5 Summary

"source water" specifies groundwater that supply private drinking sources.

Stream water, groundwater, and rainwater collection are sources used washing, cooking, other commercial activities.

According to the water's depth and the location's local geology, natural groundwater filtration may eliminate some pollutants and bacteria.

Surface water gets collected in a stream or on the land, lake, reservoir, river or ocean.
Carbon-containing molecules make up organic compounds.

Organic material-containing water can cause lethal illnesses like testicular tumours, leukaemia, kidney and thyroid cancer, lymphoma, and more.

When a considerable quantity of oil spills into the ocean and does not disperse, it creates a severe threat to acquatic life.

If water contamination is not controlled, an entire ecosystem could collapse.

3.6 Keywords

Source water: "It refers to water bodies (such as rivers, streams, lakes, reservoirs, springs, and groundwater) that supply water to both public and private wells for drinking".

Pathogens: Pathogens include bacteria, viruses, protozoa, and other microorganisms.

Eutrophication: It is a process in which chemicals aid algal development in a body of water and negatively impact aquatic life.

3.7 Self-Assessment Questions

1. Name three primary sources of water that are used for various purposes.
2. How does natural filtration of groundwater help eliminate pollutants and bacteria?
3. What are the environmental impacts of oil spills in the ocean?
4. What are the consequences of uncontrolled water pollution on ecosystems?
5. 5. Mention any three sources of water pollution.
6. 6. Categorise water pollutants of them in brief.
7. Explain the concept of eutrophication and its role in water pollution.
8. Evaluate the effectiveness of various water pollution prevention and control measures, such as wastewater treatment plants, watershed management, and regulatory policies. Discuss the challenges and limitations associated with implementing these measures.
9. Analyse how economic activities, industrialisation, urbanisation, and agricultural practices contribute to water pollution and propose strategies for sustainable water management that consider social and economic dimensions.
10. Examine the role of emerging contaminants in water pollution and their potential long-term implications.

3.8 Case Study

India faces a severe problem with water pollution, which the Yamuna River best demonstrates. This precious water has become contaminated due to rapid industry and urbanisation. Industrial effluents, untreated sewage, and solid waste dumping have produced high amounts of harmful pollutants, harming human health and the river's ecosystem. Aquatic

biodiversity has decreased, and waterborne illnesses have grown widespread. Effective solutions necessitate sustainable industrial practices, improved wastewater treatment, and community involvement, notwithstanding government initiatives like the Yamuna Action Plan. India must take extensive action to combat water pollution to protect this precious resource.

Questions:

1. How have rapid urbanisation and industrialisationcontributed ?Discuss sources that pollutants also their impact on human health and the river's ecosystem.
2. What are the consequences of water pollution in the Yamuna River for surrounding communities?
3. Explain the prevalence of waterborne diseases and their effects on the local population.

3.9 References

- "Study Session 4 the Water Cycle and Sources of Water." Study Session 4 The Water Cycle and Sources of Water. Open.edu
- "Water Sources." *Centers for Disease Control and Prevention*
- "Vikaspedia Domains." *Vikaspedia*
- "Water Quality : Guidelines, Standards and Health." *World Health Organization*, www.who.int
- *Water Pollutants - Lists, Effects, Examples, Solved Questions - TOPPR*, www.toppr.com
- AgarwalShikha, SueshSahu, Environmental Engineering and Disaster Management, DhanpatRai& Co., 2010
- Brunner R.C., Hazardous Waste Incineration, McGraw Hill Inc. 1989.
- Cunningham, W.P, Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2001.

Unit: 4

Air Pollution

Learning Objectives:

Learn about Air Pollution

Understand its sources

Understand its effects

Know about the air quality standard

Structure:

4.1 Composition of Atmosphere

4.2 Air Quality Standards

4.3 Sources and Effects of Air Pollution

4.4 Summary

4.5 Keywords

4.6 Self-Assessment Questions

4.7 Case Study

4.8 References

4.1 Composition of Atmosphere

A planet's atmosphere comprises one or more layers of gases held in place by the planet's gravity. The earth retains its atmosphere if atmosphere temperature is low and the gravity is strong.

Together with Nitrogen (78%), argon (0.9%), carbon dioxide (0.04%), and other gases, Oxygen makes up 21% of the earth's atmosphere. The gas carbon dioxide mainly causes the greenhouse effect. Outgoing terrestrial radiation, encounters opacity, yet it is clear to inward solar energy. It absorb the radiation from the earth and reflect some of it towards the surface.

The atmosphere harbours dust particles from various sources like including fine dirt, soot, smoke, dust, meteorite fragments and pollen.

4.1.1 Gases in the Atmosphere

1. **Carbon Dioxide**

   In terms of meteorology, carbon dioxide is a crucial gas. The atmosphere filters out terrestrial radiation and reflects a portion of it back toward the planet's surface. The primary factor behind the greenhouse effect is carbon dioxide. Even if the amount of other gases in the atmosphere has stayed constant over the past few decades, the volume of carbon dioxide has been rising principally due to the burning of fossil fuels. This increasing carbon dioxide concentration is the main contributor to global warming.

2. **Nitrogen**

   Nitrogen makes up about 78% of the atmosphere, but using nitrogen straight from the air is impossible.

   Proteins are also made by biotic organisms using nitrogen. The nitrogen needed by living organisms is provided through the nitrogen cycle.

3. **Oxygen**

   21% of the air is made up of oxygen. All living things need it, as breathing depends on it. It is also essential for burning.

4. **Argon**

   0.9% of the atmosphere is made up of argon. Their primary application is in light bulbs.

5. **Ozone Gas**

   Ozone is one more important constituent of the atmosphere, chiefly found b/w 10 to 50 kilometres above the globe's surface. It acts as a shield by absorbing the sun's ultraviolet radiation and blocking its path to the earth's surface. Ozone gas is present in the small quantity in the ozone layer in the stratosphere.

4.2 Air Quality Standards

An air quality standard delineates clean air as the level of a contaminant existing in outdoor air, maintaining public health safety over a specified period.. National Ambient Air Quality Standards (NAAQS) are the air quality guidelines was established by the Central Pollution Control Board (CPCB) and used nationwide.

The establishment of effective ambient air quality management relies on these criteria. In accordance with the Air Act, the initial ambient air quality standards were formulated in 1982.. Later, these standards underwent revisions in 1994. The NAAQS had its most recent revision in 2009.

The National Air Quality Monitoring Programme (NAMP) tracks the NAAQS. The CPCB executes the NAMP.

4.3 Sources and Effects of Air Pollution

4.3.1 Sources

The following are the main categories of the air pollution sources:

- Mobile sources, that includes vehicles like planes, buses, trucks, and trains
- Stationary sources, like factories, industrial areas
- Local authorities, that includes towns, cities etc.
- Natural causes, like wildfires, volcanoes etc.

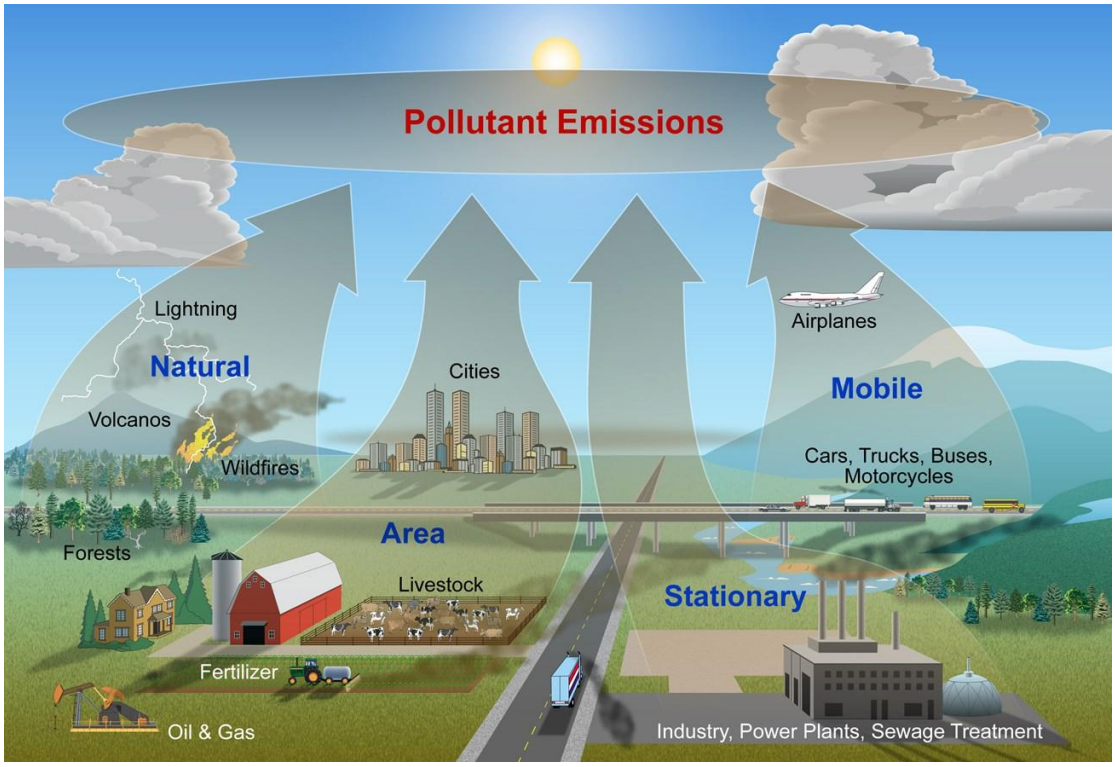

Figure 4.1: Air Pollutants

Source: National Park Service

The following is the categories of air contaminant

1. Main pollutants

Those pollutants that directly contribute to air pollution is called main pollutants. A major contaminant is sulphur dioxide, that manufacturers release.

2. Secondary Pollutants

when the primary pollutants mix and interact with one another then secondary pollutants are produced.

Causes of Air Pollution

1. Fossil Fuels

Sulphur dioxide is extensively emitted in the atmosphere during the burning of fossil fuels.

2. Automobiles

‘Vehicle emissions inflict damage upon the ecosystem’, comes from trucks, cars, buses, and jeeps. They are the main causes of human illness.

3. Farmers Activity:

The most hazardous substance is Ammonia that are emitted during agricultural activities. Hazardous compounds released by insecticides, pesticides, and fertilisers harm the atmosphere.

4. Industries and Factories

Industry and manufacturing units are leading suppliers of carbon monoxide, organic compounds, hydrocarbons, and chemicals. They degrade the value of the atmosphere by dispersing into it.

5. Mining Operations

Large machinery is utilised in mining to extract the minerals beneath the soil. The toxics that are released by the process posses a threat to the health of the people and employees.

4.3.2 Effects of Air Pollution

The following are the ways by which environment is adversely affected:

Diseases

Due to air pollution, people have developed several respiratory and cardiovascular illnesses. Lung cancer incidences have increased during the preceding few decades.

Global Warming

The release of greenhouse gases have caused a disparity in the composition of the air's gases, because of which the earth's heat has increased. Global warming is referred to as the increase in the earth’s temperature because of which, sea levels are rising, and glaciers melt. As a result of that, several locations are already underwater. There are several reasons for increasing global warming, which include the following:

Deforestation

Plants are the primary source of oxygen. They absorb CO2 and exhale O2 thereby maintaining the environmental balance.

- Employing Vehicles

Using cars produces harmful gases. Carbon dioxide and other gases are released in atmosphere when the fossil fuels are burned in vehicles.

- Chlorofluorocarbon

  Excessive use of Air conditioners and Refrigerators releases Chloroflorocarbon that has an impact on the ozone layer in the atmosphere. The Earth's surface is shielded from the sun's detrimental ultraviolet rays by the ozone layer.

- Industrial Progress

  The advent of industrialisation has resulted in the increase in the earth's temperature. The earth's temperature is rising because of industrial activities.

- Agriculture

  Various farming methods that produce methane and CO2, that results in the rise in the earth’s temperature.

Overpopulation

The amount of CO2 increases with the increasing population and contributes to global warming.

Volcanoes

Volcanoes are the major causes of global warming. Volcanoes release smoke that has a negative impact on the climate.

Acid Rain

When fossil fuels are burnt dangerous components are emitted like sulphur and nitrogen oxide. These chemicals react with water droplets, causing them to become acidic and emitting rain harmful to people, animals, and plants. Acid rain is primarily driven by sulphur and nitrogen particles that mix with the wet ingredients of rain. The sulphate and nitrogen ions that combine with water can be caused by industrial emissions or lightning strikes, which release sulphate and nitrogen ions into the atmosphere. Thus, it can have some hazardous effects, such as.

- All essential nutrients required for plant development areremoved.
- It affects the respiratory system of both humans and animals.
- It affects structures and past landmarks constructed of stone and metal.

Ozone Layer Depletion

The ozone layer is mainly found in the lowest layer of earth's atmosphere. Millions of people would get skin diseases, if there would have been no ozone layer.

Ozone layers is becoming thin because of the release of chloroflourocarbons and halons into the atmosphere. Various skin problems are caused by sun's ultraviolet radiations.

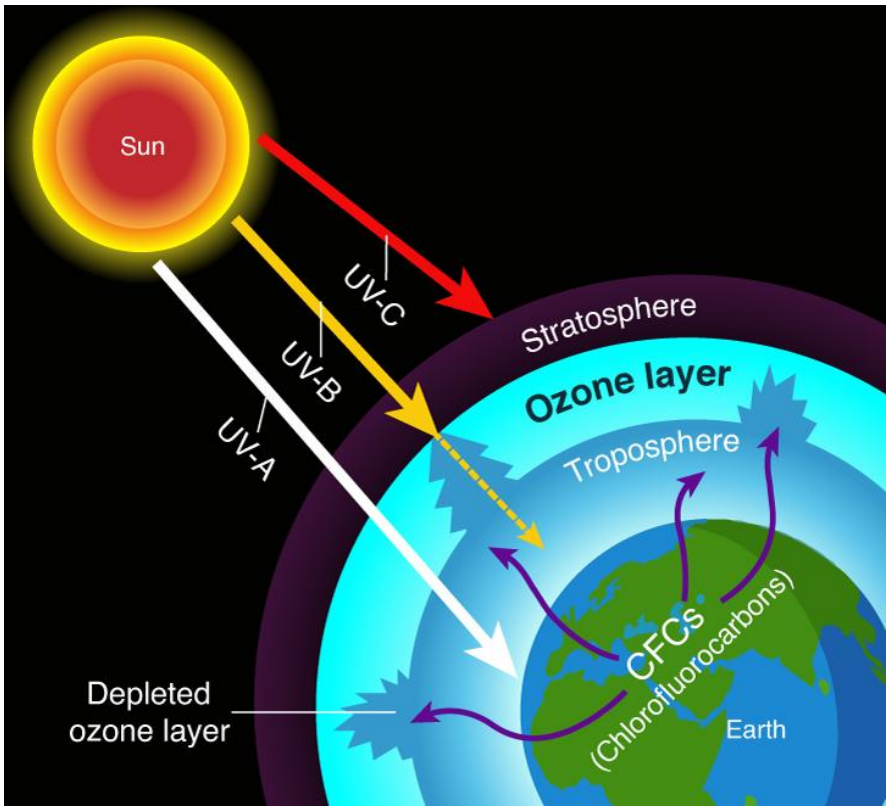

Figure 4.2: Ozone Layer Depletion

Source: Science Facts

The ozone layer's loss negatively impacts to the environment.

- Effects on Individual Health

  When the ozone layer deteriorates, people will be straight exposed to the sun's hazardous UV radiation. Human beings are susceptible to serious health issues like cancer, skin disorders, cataracts, sunburns, accelerated ageing, and weaker immune systems.

Animals

Skin and eye cancer is caused by direct ultraviolet radiations.

Environmental Impacts

Intense UV radiation may stop plants from growing, blossoming, or even performing photosynthesis. The woodlands must also endure the damaging effects of Ultraviolet light.

- Marine Life

  The affect of damaging UV light contact on plankton is considerable. Higher in the aquatic food chain are these. The destruction of plankton also impacts the species in the food chain.

One major contributor to air pollution and various sources is the greenhouse effect.

Just like glass roof of a green house, gases like CO2, traps heat**.**

During the day, the Sun emits radiations through the atmosphere.

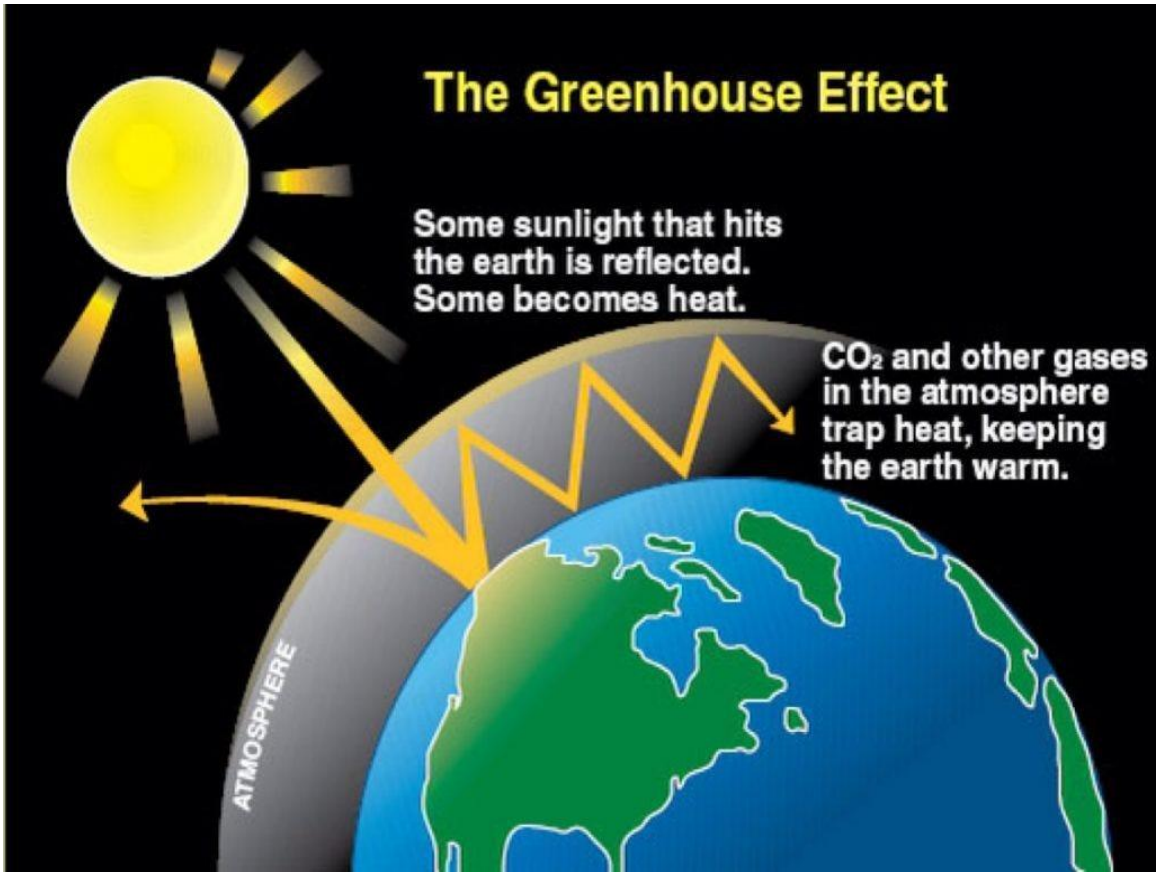

Figure 4.3: Greenhouse Effect

Source: Medium

There are two types of causes of the greenhouse effect.

Natural: The sun makes the earth habitable. 70% of the solar energy that reaches our planet passes through the atmosphere, with just 30% of it being reflected in space. The earth's surface, oceans, and atmosphere reflect and heat the gas. The heat is then returned by reflection.

Human-Induced: A portion of rays reflected during the natural greenhouse effect is reflected into space. Nearly 90% of it is taken up by greenhouse gases. This causes the gases to reflect more heat towards the earth, increasing its warmth.

4.4 Summary

- The layer of gases that surrounds a planet is called atmosphere. When the gravity is powerful, the planet's atmosphere is made up of one or more layers of gases held in place by the planet's gravity.
- An air quality standard sets the benchmark for clean air, determining the acceptable level of a contaminant in outdoor air over a specified period to ensure public health is not compromised.
- During the burning of fossil fuels sulphur dioxide is released. When fossile fuels are burned inefficiently that also contributes to air pollution.
- Industrial activities are the primary sources of carbon monoxide, organic compounds, hydrocarbons, and chemicals.

4.5 Keywords

- **Atmosphere:** The layer (or layers) of gases that surround a planet and are kept in place by the planetary body's gravity.
- **The air quality standard** defines “clean air as the amount of a contaminant present in outdoor air without endangering public health averaged over time.”
- **National Ambient Air Quality Standards:** The Central Pollution Control Board (CPCB) established and used these air quality guidelines nationwide.
- **Greenhouse Gas:** Any gas that can absorb infrared radiation (net heat energy) emanating from the Earth's surface and reradiating it to the surface is a greenhouse gas and contributes to the greenhouse effect.

4.6 Self-Assessment Questions

1. What are the two most abundant gases in the Earth's atmosphere, and what are their respective percentages?
2. Explain the relationship between fossil fuel combustion and the release of sulphur dioxide and carbon monoxide release into the atmosphere. How do these pollutants contribute to air pollution?
3. Discuss the role of hydrochlorofluorocarbons, halons, and chlorofluorocarbons in the depletion of the ozone layer. How do these emissions impact the atmospheric environment, and what are the potential consequences of ozone layer depletion?
4. Explain the phenomenon of acid rain and its connection to air pollution. What are the primary pollutants responsible for acid rain, and what are this phenomenon's environmental and ecological impacts?
5. Describe the impact of air pollution on climate change. How do greenhouse gases and air pollutants interact to influence the Earth's climate, and what are the consequences of this interaction?
6. What are the primary sources of air pollution, and how do they contribute to the deterioration of air quality?
7. Explain the role of industrial activities in air pollution.
8. Discuss the primary pollutants emitted during combustion and their environmental and health impacts.
9. What are the primary greenhouse gases responsible for the enhanced greenhouse effect, and how do they contribute to global warming? Discuss their sources.
10. What are the primary substances responsible for ozone depletion, and how do they affect the ozone layer?

4.7 Case Study

The 1980s saw a significant acid rain outbreak in the Scandinavian region, which hurt the ecology. Wind currents brought industrial emissions from nearby nations, especially sulphur dioxide and nitrogen oxides, precipitating acid rain in Norway, Sweden, and Finland. Acid rain caused lakes and rivers to become more acidic, which killed aquatic life and reduced biodiversity. In addition, woods were harmed by acid rain, which inhibited tree development and caused a loss of foliage. The forestry and fishery industries experienced losses, having a

considerable negative economic impact. The afflicted nations established stricter emission limits and international partnerships to reduce pollution emissions to fight this problem.

Questions:

1. Describe the environmental impacts of acid rain on aquatic ecosystems in the Scandinavian region during the 1980s. How did the acidification of lakes and rivers affect marine life and biodiversity in the affected areas?
2. Explain the consequences of acid rain on forest ecosystems in Norway, Sweden, and Finland. Discuss the specific damages caused to forests, including the effects on foliage and tree growth and the subsequent economic implications for the forestry industry.
3. Discuss some measures to prevent or reduce acid rain possibilities.

4.8 References

1. AgarwalShikha, SueshSahu, Environmental Engineering and Disaster Management, DhanpatRai& Co., 2010
2. Brunner R.C., Hazardous Waste Incineration, McGraw Hill Inc. 1989.
3. Cunningham, W.P, Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publishing House, Mumbai, 2001.

Unit: 5

Noise Pollution

Learning Objectives:

1. Know about Noise Pollution in detail
2. Understand its sources
3. Learn about its effects
4. Learn ways to control noise pollution

Structure:

5.1 Noise Pollution: An Introduction

5.2 Levels of Noise

5.3 Sources and Effects of Noise Pollution

5.3 Prevention of Noise Pollution

5.4 Summary

5.5 Keywords

5.6 Self-Assessment Questions

5.7 Case Study

5.8 References

5.1 Noise Pollution:

Introduction

Any upsetting sound that interferes with people's and other species' health and well-being is called sound pollution.

In actuality, sound is uncomfortable and dangerous.

Noise pollution is created and spread by heavy noise created through different sources such as dj, loud volume songs, temple rings, etc.

5.1.1 Noise Pollution - Types

The three categories of pollution are as follows:

Vehicle Noise
Residential Noise
Industrial Noise
Vehicle Noise

It primarily consists of traffic noise, which has been louder in recent years as more cars have been on the road. The increase in noise pollution causes age-related hearing loss, headaches, hypertension, and other problems.

Residential Noise

It includes noise made by appliances, household tools, etc. The primary sources are things like speakers, transistors, and musical instruments.

Industrial Noise

The loud noise is a result of the heavy industrial machinery. Numerous studies have found that industrial noise pollution reduces hearing capacity by 20%.

5.2 Levels of Noise

The hearing loss increases with rising noise volume. The danger of audible range loss increaseswith the experience length andif rest periods are not provided for the ears between exposures.

A motor cycle engine makes 95 db morethan regular sound, around 60 db more than a whisper. This may harm the hearing,as more than 70db is harmful for hearing.

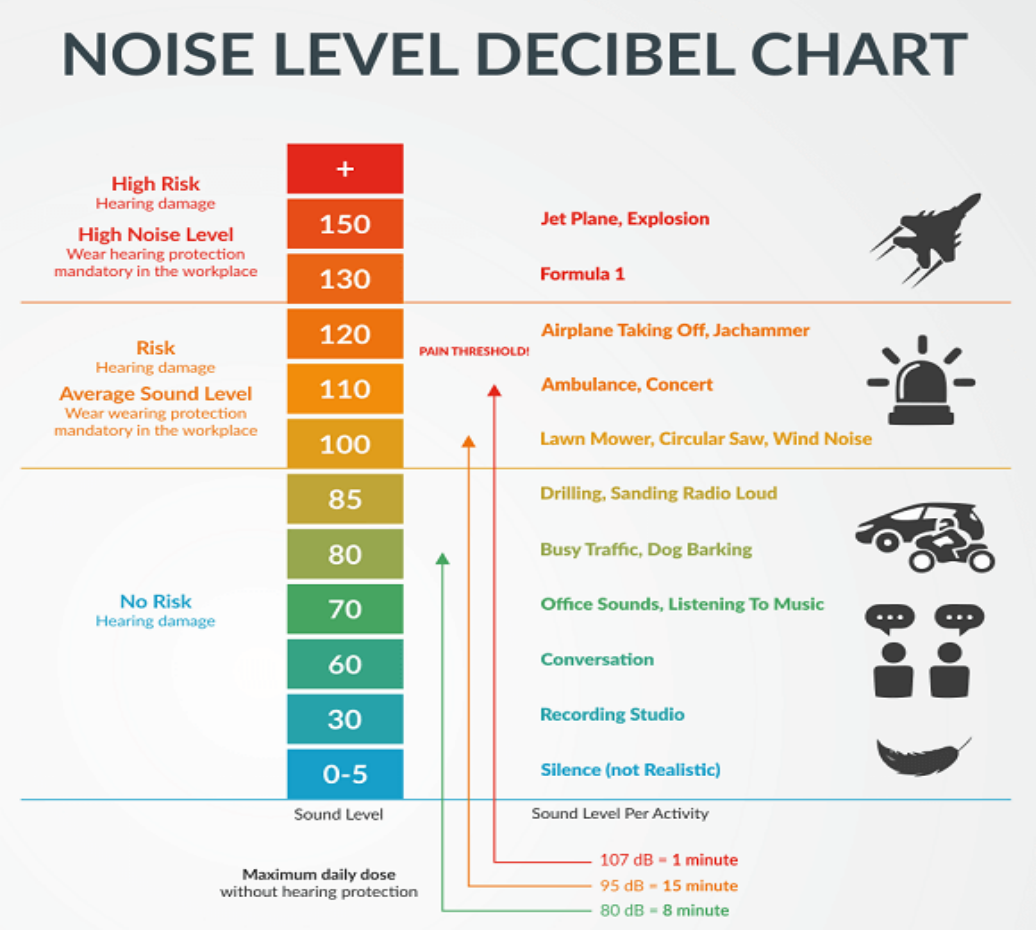

Figure 5.1: Noise Level Decibel Chart
Source: Electronics Hub

Figure 5.1 demonstrates the noise level produced by different human activities and instruments.

5.2.1 Noise Exposure Limits

Occupational hazards such as noise are well known and must be managed.

As each nation has noise exposure limitations, professionals must check the local legislation to determine the standards established for the country where their firm conducts business.

Country	Eight Hours dB(A) experience	peak Hours pressure level
“China	70-90	115
India	90	140
Netherlands	85	140
Poland	85	135
United Kingdom	85	140
USA	90	140”

Table 5.1: Noise Limitations By Different Countries

Source: IOSH

Although the restrictions differ from nation to nation, a time slanted normal (TWA) of 85 dB (A) is the generally acknowledged benchmark. TWA estimates a worker's daily exposure to dangers like frequency.

5.3 Sources and Effects of Noise Pollution

5.3.1 Sources/Causes

Industrialisation

Every big industry have huge machine that makes lot of noise ,and other industry appliances make more noise.

Social Occasions

Every communal events have huge noise whether its party marriage ,disk, pub, worship and others.

Transportation

Serious sound is generated by various cars and automobiles including trains and its very hard to adjust with them.

Building Activities

All construction work and mining work

Household tasks

People utilise devices heavily in their daily lives and are constantly surrounded by them.

Audible Air Traffic Noise

Although many find it hard to believe, air travel also significantly increases levels of noise pollution. A single aircraft can generate up to 130 dB of noise.

5.3.2 Effects of Noise Pollution

Psychological Problems

Excessive noise pollution can harm psychological health at places of employment, including offices, construction sites, pubs, and even our homes. “According to studies, excessive noise levels can contribute to aggressive behaviour, sleep disruption, ongoing stress, weariness, sadness, anxiety, hysteria, and hypertension in both people and animals. When there is more

noise, individuals become more irritated and lose patience more quickly. Later in adulthood", these can lead to more severe and persistent health problems.

Insomnia disorders

Although interfere with your sleep, which can cause annoyance and uncomfortable circumstances

Improper sleep, fatigue will impact your performance at work and home.

Impact on Wildlife Life

Noise pollution affects animals much more than human beings.

And various animals are impacted by human noise.

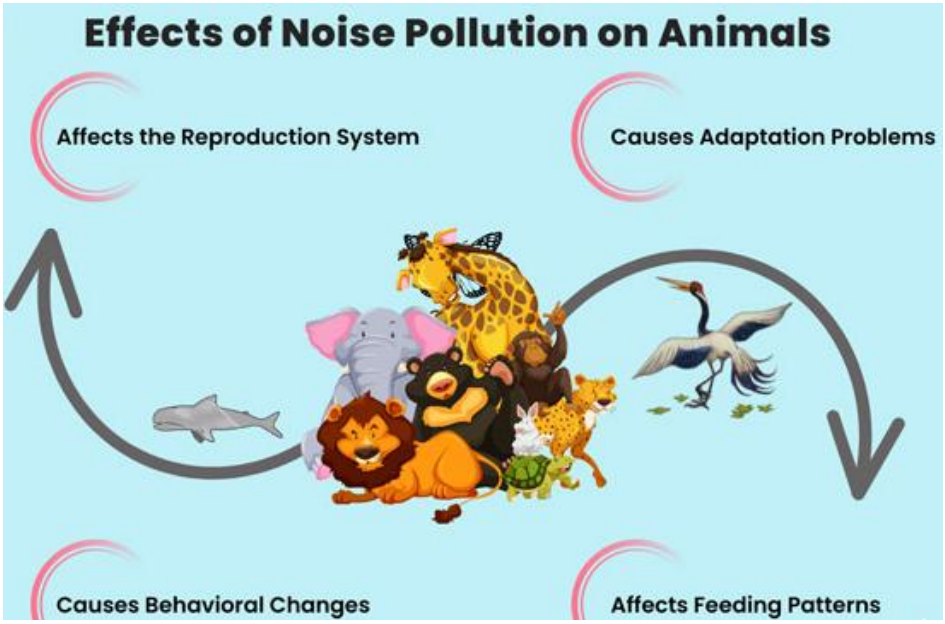

Figure 5.2: Effects of Noise Pollution on Animals

Source: Earth Reminder

They are more prone to losing their bearings and have numerous behavioural issues. Animals in the wild can experience hearing loss, which makes them easy prey and causes population declines. Others lose their hunting skills, upsetting the ecological equilibrium.

5.4 Prevention of Noise Pollution

At present there are few options for dropping sound pollution.

1. Establishing some rules and regulations.

2. To ensure the public place hospitals and other places have less noise.

3. The distance between residential areas and noise sources, such as airports, dump items occasionally should be checked and maintained.

4. Pedestrian areas should be established.

Some other practices that can be applied by an individual in their effort to reduce noise pollution are as follows:

Ensure area's noise stage and reduce your sound production.
Adhere to areas with lots of trees, make low noise stage.
Use the appropriate noise absorbents with noisy machines.
Use headphones when listening to music.
Use public transport or electric vehicle.
Make sure you will check your car regular basis

5.5 Summary

- Any upsetting sound that interferes with people's and other species' health and well-being is called noise pollution.
- "Noise pollution is defined by the World Health Organisation (WHO) as noise levels greater than 65 dB".
- Although the restrictions differ from nation to nation, the generally acknowledged benchmark.
- TWA estimates a worker's daily exposure to dangers.

5.6 Keywords

- **Noise Pollution:** Any upsetting sound that interferes with people's and other species' health and well-being is called noise pollution.
- **Time weighted average:** It is a way of estimating a worker's daily exposure to dangers like noise; it refers to the average frequency at which a worker is exposed to an unfavourable condition like noise over a set period
- **Psychological problems:** These include aggressive behaviour, sleep disruption, ongoing stress, weariness, sadness, anxiety, hysteria, hypertension, etc.
- **Ecological Equilibrium:** It is a dynamic equilibrium within an organism community when genetic, species and ecosystem diversity stay largely stable and are only gradually changing due to natural succession.

5.7 Self-Assessment Questions

1. What simple measures can individuals take to reduce noise pollution in their daily lives?
2. How does prolonged exposure to noise pollution contribute to chronic health conditions?
3. How can urban planning and architectural design contribute to minimising the impacts of noise pollution on human health and well-being?
4. What is the concept of time-weighted average (TWA), and how is it used to assess noise exposure?
5. What are the cognitive effects of noise pollution on brain activity and concentration levels?
6. What is the generally accepted benchmark for noise exposure in occupational settings?
7. How does the World Health Organisation define noise pollution?
8. What is the recommended noise level threshold set by the WHO?

5.8 Case Study

A study examined how noise pollution affects avian behaviour and communication among urban bird species. Field research showcased that loud anthropogenic noise interferes with bird vocalisations, which impacts mate attractiveness, territorial defence, and breeding

success. Additionally, stress reactions brought on by noise affect foraging habits and lower foraging effectiveness. The study emphasised the necessity for noise reduction measures to save urban bird populations and their ecological integrity.

Questions:

1. How does noise pollution affect the communication and behaviour of wildlife species in urban environments?
2. What are the observed effects of noise pollution on the reproductive success and breeding behaviours of animals in urban areas?
3. In what ways does noise pollution influence the foraging patterns and ecological interactions of wildlife species within urban ecosystems?

5.9 References

1. "Noise: Sound Levels and Their Relevance." *IOSH*
2. "Causes and Effects of Noise Pollution on Humans and Animals." *Conserve Energy Future*.
3. Alimohammadi, Iraj, et al. "Effect of Chronic Noise Exposure on Aggressive Behaviour of Automotive Industry Workers." *The International Journal of Occupational and Environmental Medicine*, U.S. National Library of Medicine, Oct. 2018.

Unit: 6

Solid Waste Management

Learning Objectives:

Learn about Solid Waste Management

Learn to classify waste

Understand its composition

Know its characteristics

Structure:

6.1 Municipal Waste- An Introduction

6.2 Classification of Solid Waste

6.3 Composition of Solid Waste

6.4 Characteristics of Solid Waste

6.5 Summary

6.6 Keywords

6.7 Self-Assessment Questions

6.8 Case Study

6.9 References

6.1 Municipal Waste- Introduction

Any undesired material in our environment or from everyday products that is neither liquid nor gas is considered solid waste. These wastes need to be disposed of carefully by following recognised protocols. Solid waste management has been an issue due to improper disposal for as long as people have lived in towns and neighbourhoods.

Figure 6.1: Solid Waste Management
Source: Netsol Water

Municipal Solid Waste

This includes common goods that discarded by the people.

Persistent wastes like plastic film and non-recyclable packaging make up most trash streams in cities with well-developed waste recycling systems. Municipal solid waste categories eliminate industrial, agricultural, medical, and radioactive waste and sewage sludge. The municipality is in charge of collecting trash within a given area.

The term "residual waste" describes garbage from residential sources that have not been moved or separated for processing.

6.2 Classification of Solid Waste

There are two main categories that are Biodegradable and Non-Biodegradable. At the same time, Municipal Solid waste consists of both, some other types of substantial waste fall under the two. Some of them are mentioned below.

Figure 6.2: Classification of Solid Waste
Source: INTOSAI

Dangerous Waste

"Hazardous waste" describes a specific category of dangerous material. Industrial and medical waste are regarded as hazardous because they contain harmful substances.
Toxic, incredibly flammable, or explosive, hazardous wastes can damage people, pets, and plants.

There are two types of hazardous waste i.e., household and industrial.

Hospital Waste

Hospital waste is produced by the hospitals during medical treatments of people or animals and the study, creation and testing of biological products.

These wastes are very contagious and can pose a severe risk to human health.

Industrial Wastes

This includes waste left behind after manufacturing and other industrial processes. They have a wide variety of compounds. They are treated differently from municipal wastes due to this.

Sewage Wastes

These wastes are solid leftovers from sewage processing.

Grit, an inorganic component of raw sewage that is isolated during the first stage of treatment, must be buried or disposed of right away because it entraps putrescible organic materials that could contain infections. Most treated, dewatered sludge can be used to improve soil, but doing so is only sometimes cost-effective. Therefore, unless specific planning is done for disposal, the solid sludge enters the municipal trash stream.

6.3 Composition of Solid Waste

Waste compositions and the classifications employed to gather information on waste composition in Municipal Solid Waste differ significantly in various nations and areas.

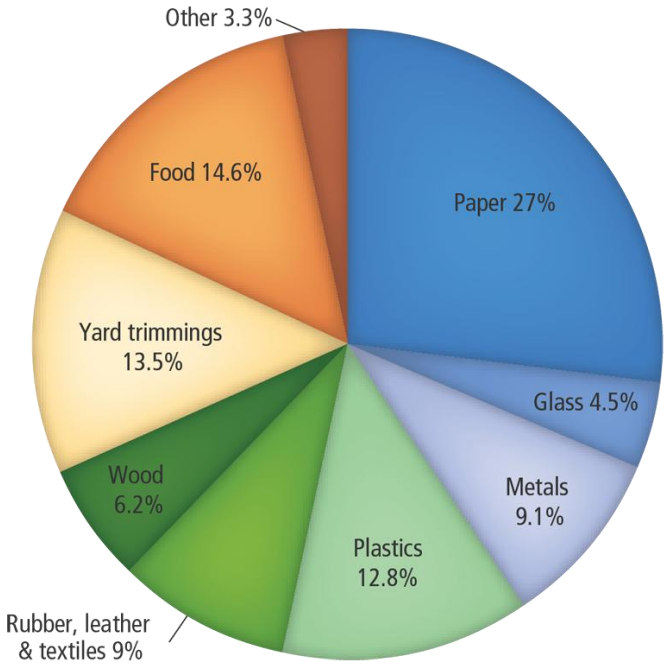

Figure 6.3: Composition of Municipal Solid Waste
Source: EPA

Wastes such as food, textiles, paper, and yard waste are all degradable. Non-fossil carbon is also present in small amounts in ash, dust, rubber, and leather but is hardly biodegradable. The majority of the fossil carbon in MSW is found in some textiles and plastics (particularly plastics found in disposable diapers). Small amounts of fossil carbon can also be found in paper and synthetic leather.

Chemical Composition of Solid Waste

- Heat content, called calorific value, is the quantity of heat energy created when the trash is burned.
- Moisture content is the amount of water in the waste
- Ash content is the amount of material left over after burning the waste

6.4 Characteristics of Solid Waste

There are two categories of solid waste:- Physical Characteristics and Chemical Characteristics.

Physical Characteristics

The physical characteristics of waste are

Density

It is an important consideration while designing a solid waste management system. The densities of solid wastes vary significantly depending on geographic location, year's season, and amount of time in storage, so extreme caution should be taken when choosing typical values.

It has been discovered that the typical value for compaction vehicles.

Moisture Content

The moisture content is when weight of water is divided by the total weight of the trash. The cost of collection and transportation is raised because it makes solid waste heavier. In

determining whether waste treatment by incineration is economically feasible or not, the moisture content is critical factor.

The extreme level is when moisture content range is 20 to 40%.

Size

It’s crucial to consider the size and size distribution of the component elements when recovering materials, especially mechanical methods in solid wastes.
Because it is crucial to measure the size distribution of waste stream particles.

Chemical Characteristics

The chemical characteristics of waste are

1. Lipids

The primary sources of lipids are group of substances like oils, cooking oils, grease, etc.
Lipids become liquid at temperatures just slightly higher than ambient.
Despite being biodegradable, lipids degrade very slowly because they are poorly soluble in water.

2. Carbohydrates

Carbohydrates which include sugar predominantly found in food and yard waste. Carbohydrates are easily biodegraded into substances like methane, carbon dioxide, and water.

3. Proteins

Proteins comprise an organic acid with an amine group (NH2) that has been replaced. Proteins are substances having the elements carbon, hydrogen, oxygen, and nitrogen.
They are primarily discovered in gardens and food waste. These compounds' partial breakdown may lead to the generation of amines with foul scents.

4. Natural Fibres

Natural fibres, which include the biodegradable substances cellulose and lignin, are present in food waste, paper goods, and yard trash.

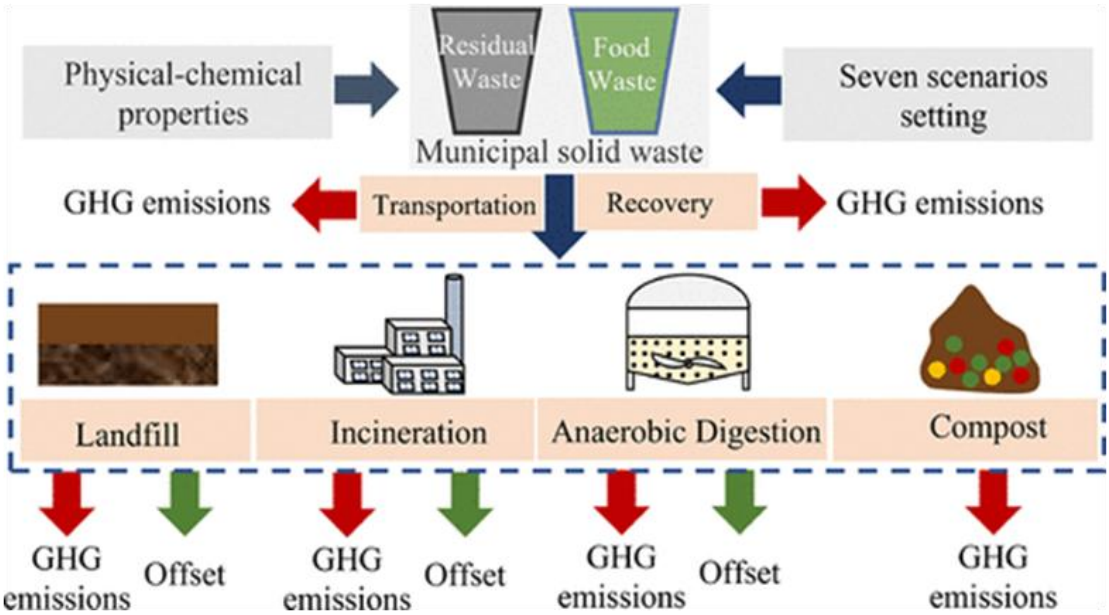

Figure 6.4: Characteristics of Solid Waste
Source: ACS Publications

6.5 Summary

- Any undesired material in our environment or from everyday products that is neither liquid nor gas is considered solid waste.
- MSW includes waste of common goods discarded by the general public.
- Municipal solid waste categories eliminate industrial, agricultural, medical, and radioactive waste and sewage sludge. The municipality is in charge of collecting trash within a given area.
- Solid waste can be categorized in two categories i.e., biodegradable and non-biodegradable.
- Hazardous waste in industrial sector is mainly produced by the manufacturing and industrial processes.
- Hospital waste is produced by the medical treatments of people or animals and the creation and testing of biological products.

- ❖ Moisture content is economically feasible because for water evaporation and for raising the temperature of water vapour, wet waste requires energy.

6.6 Keywords

Solid Waste: Any undesired material in our environment or from everyday products that is neither liquid nor gas is considered solid waste.

Residual Waste: It describes garbage from residential sources that have yet to be moved or separated for processing.

Calorific value: The quantity of heat energy created when the trash is burned.

6.7 Self-Assessment Questions

1. Define solid waste.
2. What does municipal solid waste (MSW) include, and who is responsible for its collection?
3. How can solid waste be categorised into biodegradable and non-biodegradable?
4. What are some examples of industries that produce hazardous waste, and what are the potential dangers associated with exposure to such waste?
5. What is hospital waste, and what are its sources and characteristics?
6. How does the moisture content of waste affect the feasibility of waste treatment by incineration?
7. Write a note on the physical characteristics of solid waste.
8. Write a note on the chemical characteristics of solid waste.
9. Write a short note on Municipal Solid Waste.
10. Write a short note on Municipal Solid Waste and Industrial waste composition.

6.8 Case Study

The Brazilian city of Curitiba is an excellent case study in solid waste management. Curitiba adopted an innovative waste management system that prioritised recycling, waste reduction, and community involvement in the 1970s in response to rising garbage creation and a shortage of landfill space. Citizens were urged to sort their rubbish into various categories as

part of the city's extensive recycling programme. Curitiba also established a network of parks and green spaces that acted as trash collection sites, fostering neighbourhood involvement and instruction. Due to these activities, Curitiba saw reduced landfill usage, a 70% recycling rate, and much better environmental conditions.

Questions:

1. How did Curitiba, Brazil, successfully implement a comprehensive recycling program as part of its solid waste management system, and what factors contributed to its high recycling rate of approximately 70%?
2. What were the innovative strategies and community engagement approaches employed by Curitiba to encourage waste reduction and segregation, including establishing green spaces and parks as waste collection points?
3. What were the environmental and social benefits observed in Curitiba due to its waste-to-energy plants, which converted non-recyclable waste into electricity, and how did this approach contribute to reducing landfill use and improving overall environmental conditions in the city?

6.9 References

1. "Classification of Solid Wastes." *Environmental Information System*, www.envis.org
2. "Solid Waste: Sources, Composition and on-Site Storage."
3. "Environmental Engg." *EE: Characteristics of Solid Waste*,