



**GRT INSTITUTE OF
ENGINEERING AND
TECHNOLOGY, TIRUTTANI - 631209**

Approved by AICTE, New Delhi Affiliated to Anna
University, Chennai



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION 2017

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C 3 0 0 3

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers –energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

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Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial /Agricultural.

UNIT III NATURAL RESOURCES

10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.



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UNIT V HUMAN POPULATION AND THE ENVIRONMENT

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Population growth, variation among nations – population explosion – family welfare programme - environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

TEXT BOOK:

1. Benny Joseph, =Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, =Introduction to Environmental Engineering and Science', 2 edition, Pearson Education, 2004.

REFERENCES:

1. Dharmendra S. Sengar, =Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, —Textbook of Environmental StudiesI, Universities Press (I) PVT, LTD, Hyderabad, 2015.
3. Rajagopalan, R, =Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, —Environmental ScienceI, Cengage Learning India PVT, LTD, Delhi, 2014

UNIT - I

Environment, Ecosystem & Biodiversity

Environment - Definition (1)

Each & Everything around us is called as Environment.

U ⇒ Environ - Surroundings which has been derived from the French word.

(ii) Definition (2) Sum of total ^{of} all the living & non-living things around us - known as Environment

Types of Environment

- 1) Natural Environment - Water, soil etc.
- 2) Man-made Environment - Railway, School etc.

SCOPE OF ENVIRONMENTAL STUDIES :-

- ⇒ To preserve the Environment.
- ⇒ To solve Environmental problems.
- ⇒ To conserve the Natural Resources.
- ⇒ To identify the Environmental problems.

IMPORTANCE (OR) SIGNIFICANCE OF ENVIRONMENTAL STUDIES

To solve the Environmental problems, we should be aware about the knowledge of Environmental studies

- ⇒ Help to develop the Environment without any destruction
- ⇒ Environment have direct contact with the Human beings

=> Can gain the knowledge regarding different kind of Environment

NEED FOR PUBLIC AWARENESS

=> Due to many reasons like Increase in Population, Urbanisation etc Human beings use to degrade the Environment. To protect the Environment Supreme Court has ordered to conduct Awareness program through Non-government agencies.

Types Pressure Group, Watch dog, Advisory Council

RISK & HAZARDS OF Environment

① Physical Hazards :-

Hazard => Substance that can hurt.

- Physical hazard :- Physical hazards are the substance that may threaten the physical safety.

Eg Heat, Noise etc..

Health effects due to physical hazards :-

Radiative radiations -> Cancer

UV radiation -> Skin Cancer

Global Warming -> Famine

CFC -> Effects O₃ Layer

Noise -> Human ear

(2)

2) Chemical Hazards:- Chemical Hazards Causes due to Chemical Accidents such as fire, Explosions etc

Example :- Gases, acids etc

Health effects due to Chemical Hazards

Fossil Fuel → Lung disease

Industrial Effluent → Cause Cancer

Pesticide → affect food chain

Heavy Metal → pollute water.

3) Biological Hazards:- Materials derived from Animals & Plants Cause harm to human beings.

Health effects due to Biological Hazards

Bacteria, Virus, & parasite → Malaria, Diarrhoea, Cholera.

Prevention & Control Measures of Hazards:

1) Ventilation should be improved

2) Use of UV lamps

3) Use of protective Equipment like Masks, gloves etc

4) Elimination of the sources.

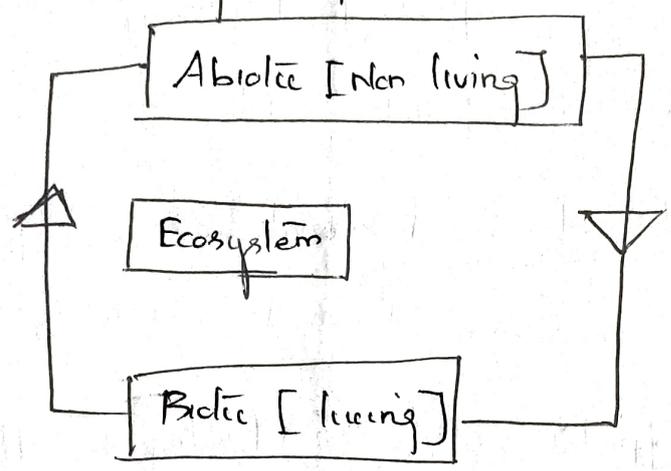
Ecosystem :- Organisms interacting among themselves & with the environment is called as Ecosystem

Living things + Living things }
Living things + Non-living things } = Ecosystem

Structure of an Ecosystem :-

Structure → Various Components

Structure = Living Components + Non-living Components



Abiotic Components

It includes Physical & Chemical Components

a) Physical Component : Air, Water, Soil etc

b) Chemical Component :- C, H, O, P, Al, Zn etc

Biotic Component :- It includes Autotrophic &

a) Autotrophic Components Heterotrophic Components

Auto → self Trophs → producing

→ Derive Energy from sunlight & produce their own food

Eg plants, Bacteria etc

(5)

Heterotrophic Components :- It depends on others [producers] for the food.

- a) Macro Consumers - Omnivores
- b) Micro Consumers - Bacteria & fungi

FUNCTIONS OF AN ECOSYSTEM

⇒ Flow of Energy & Cycling of Nutrients

- a) primary function → to produce starch [Food]
- b) Secondary function → Distributing Energy (as) food
- c) Tertiary function → Death of an organism

⇒ Function of an ecosystem can be understood by the following terms :-

- 1) Energy & Material flow
- 2) Food chain
- 3) Food web
- 4) Food pyramid

1) Energy Flow

- Solar Energy is transformed to Chemical Energy in photosynthesis by the plants (producers)
- Remaining Energy is transferred to other living organisms [Consumers]
- Conversion is governed by the Law of thermodynamics

(6)

→ I Law of Thermodynamics

"Energy can be neither created nor destroyed"

→ II Law of Thermodynamics

Whenever Energy is transformed there is a loss of Energy due to heat"

(*) ^{2M} Food Chain: The sequence of eating & being eaten in ecosystem is known as food chain

^{veg} Plant → animal.

^{hna} Plant → deer → lion.

Types

- 1) Grazing Food chain
- 2) Detritus Food chain

Food web:- The interlocking pattern of the food chain is called as food web.

Food pyramid:

Types of Ecosystem : (7)

Forest Ecosystem :- Supports Many animals & birds
→ Occupies 19% of total land area for forest.

Types

- 1) Tropical Rain forest →
- 2) Tropical deciduous forest
- 3) Tropical Scrub forest
- 4) Temperate Rain forest
- 5) Temperate deciduous forest.

Tropical Rain forest

- High temperature
- Found Near the Equator

Tropical deciduous forest

- Away from the Equator.
- Warm climate
- Animals like Fox, rabbit, deer

Tropical Scrub forest

- dry climate
- Animals like Fox, deer etc.

Temperate Rain forest

- Adequate Rainfall.
- have Red wood trees, cat, lion etc

Temperate deciduous forest

- Moderate temperature
- Includes cat, Fox, bear etc

Characteristics

- (8)
- 1) Forests have warm temperature & Moderate rain
 - 2) Maintains climate & rainfall
 - 3) protects wild animals & plants
 - 4) Contains rich organic matter

Structure & function of Forest Ecosystem

Biotic Components:

Producers :- trees, shrubs etc.

Consumers :-

Primary :- goat deer, insect etc

Secondary :- Birds, snake etc

Tertiary :- lion, tiger etc

Decomposers :- dead plant & organic matter

GRASS LAND ECOSYSTEM

-> 20% of land surface.

Types

- 1) Tropical grassland
- 2) Temperate grassland
- 3) polar grassland:

Tropical

- > High temperature
- > Moderate rainfall
- > Includes, shrubs & trees

(9)

Temperate grassland :-

→ doesn't includes Shrubs (or) Trees

→ Found in Centre of Continents

Polar grassland :-

→ Found in polar region

→ Includes Animals like Wolf, Fox etc.

Characteristics of grassland Ecosystem :-

→ Land Occupied by grass

→ Rich in Nutrients

→ Uneven Rainfall

Structure & Function of the grassland :-

Abiotic Components:

Nutrients C, H, O, P, S etc

Biotic Components:

→ Producers :- Grasses

→ Consumers

Primary Consumers :- Cows, buffaloes, etc

Secondary Consumers :- Eagles etc

Decomposers :- Fungi & Bacteria

DESERT ECOSYSTEM (10)

→ It occupies about 35% of our land area

Types of Desert Ecosystem:-

- 1) Tropical desert
- 2) Temperate desert
- 3) Cold desert

Tropical desert

→ Wind blown sand dunes are common

Temperate desert

- Very hot during summer
- Very cool during winters

Cold desert

→ Low temperature:

Structure & Function of An ^{desert} Ecosystem

Abiotic Components: Temperature, Rainfall & Sunlight

Biotic Components :-

Producers: Shrubs, grasses & trees

Consumers: Mice, foxes, reptiles

Decomposers: Fungi & Bacteria

AQUATIC ECOSYSTEM

→ Deals with water bodies

Two types:

1) Freshwater life zones.

Eg: ponds, streams, lakes, rivers

2) Saltwater life zones :-

Eg: Oceans, Estuaries

Freshwater Ecosystem :-

Pond Ecosystem - water is stagnant:

Characteristics of pond Ecosystem :-

- 1) Pond is temporary.
- 2) Stagnant.
- 3) It can be polluted easily.

Structure & function of a pond Ecosystem :-

Abiotic :- Temperature, light, water etc

Biotic :-

Producers :- Phytoplankton, Microphytes

Consumers :- Primary Consumers : zooplankton (Microorganism)

Secondary Consumers : Beetles & Fish

Tertiary Consumers :- Large Fish

Decomposers :- Fungi & Bacteria

Lake Ecosystems :-

(12)

→ Shallow water bodies

Types

- 1) Oligotrophic Lakes
- 2) Eutrophic "
- 3) Dystrophic "
- 4) Volcanic "
- 5) Meromictic "
- 6) Artificial "

Characteristics

- 1) Shallow fresh water body
- 2) permanent water body
- 3) helps in irrigation

Structure & function of Lake Ecosystem :-

Abiotic Component :- temperature, light, proteins

Biotic Component :-

Producers :- Algae, Phytoplankton

Consumers :-

Primary Consumers :- Protozoans

Secondary Consumers :- Small Fishes

Tertiary Consumers :- Large Fish

Decomposers :-

Fungi & Bacteria

Characteristics of Ocean Ecosystem

- 1) Occupies large area
- 2) Contains salt
- 3) Rich in Biodiversity
- 4) Moderates the temperature on the Earth

Structure & function of Ocean Ecosystem :-

Abiotic Components :- Temperature, light, salt etc

Biotic Components :-

Producers :- Algae & phytoplankton

Consumers :-

Primary Consumer :- Fish

Secondary Consumer :- Mackerel

Tertiary Consumer :- Cod

Decomposers :- Fungi & Bacteria

ESTUARINE ECOSYSTEM

→ Enclosed Coastal area at the Mouth of the river

Characteristics of Estuarine Ecosystem

- Water changes periodically
- Salinity becomes high during Summer

RIVER ECOSYSTEMS (15/11)

→ Running water:

Characteristics of River Ecosystem :-

- 1) Fresh water & Free flowing System
- 2) Dissolved Oxygen Content is more
- 3) Large Amount of Nutrients

Structure & Function of River Ecosystem

Abiotic Components :- Temperature, light, Nutrients

Biotic Components :-

Producers :- algae, Phytoplankton, grasses

Consumers

Primary Consumers :- Insects, Snails etc

Secondary Consumers :- Birds & Mammals

Decomposers :- Bacteria & Fungi

SALTWATER ECOSYSTEMS [OCEAN ECOSYSTEMS] :-

→ Covers $\frac{2}{3}$ of the Earth's Surface

Zones of Ocean Ecosystem :-

- 1) Coastal zone
- 2) Open Sea
- 3) Euphotic zone
- 4) Benthic zone
- 5) Abyssal zone

Ecological Succession : (15)

Replacement of one Community by another Community till the development of stable Community is called as Ecological Succession

Process of Ecological Succession :

1) Nudation : Development of Bare area

2) Invasion : Establishment of one (or) more species

a) Migration : ^{seeds here} Brought out by wind

b) Establishment : Seeds then germinate & grow on the land

3) Competition : Competition with the same species

4) Reaction : Living organisms may modify the Environment by taking Nutrients & called as Reaction.

5) Stabilization :- Stable Community.

Oxygen cycle :- three types (stages)

1) Atmosphere

2) Biosphere

3) Lithosphere

Atmosphere :- gases lies above the Earth's surface.

Biodiversity

Biodiversity - definition

Bio → life diversity → Variety

It is defined as the "Variety and Variability among all group of living organisms"

Classification of biodiversity :-

- Genetic diversity
- Species diversity
- Community (or) Ecosystem diversity

Genetic diversity :- A species with different genetic characteristics is termed as genetic diversity.

⇒ Variation in genes.

Examples: Rice Varieties & Wheat Varieties

Species diversity :- It is nothing but the diversity between different species

→ Group of organisms of the same kind.

Eg Fruits: Apple, Mango.. etc

Animals: Lion, Tiger, Bison.. etc

Community (or) Ecosystem diversity :- It is a diversity at habitat level. [living place].

Eg River Ecosystem.

It includes Fish, insects, algae, & variety of plants
Interaction between living & non-living organisms

BIOGEOGRAPHICAL CLASSIFICATION OF INDIA :-

→ It is important to know about the distribution of plants & animals [Flora & Fauna] of our Country

Since biogeographers classified our Country into seven zones as follows

S.No	Biogeographic Zone	Biotic Province	Total Area
1	Trans-Himalayan Region	Upper Regions	186200
2.	Himalayan Mountain	North West Himalaya	6900
		West Himalaya	72000
		Central Himalaya	12300
		East Himalaya	83000
3.	Desert	Kutch	45000
		Thar	18000
		Ladakh	NA
4.	Semi-Arid	Central India	107600
		Gujarat	404400
5.	Western Ghats	Malabar Coast	59700
		Western Mountains	99300
6.	Deccan Peninsula	Central plateau	198000
		Eastern plateau	217000
7.	Gangetic Plain	Upper & Lower Gangetic plain	206400 & 153000

Illegal Trade :-

Illegal trade on Wild Animals reduce the biodiversity

Development Activities

Construction of dams, discharge of Industrial Effluents etc.

Poaching → killing (or) hunting the animals

→ Subsistence poaching :- Consuming the animals

→ Commercial poaching :- Hunting the animals for Food & selling their Products.

Factors Influencing Poaching

- 1) Human population
- 2) Commercial Activities

Remedial Measures

- 1) Illegal hunting & trading should be stopped.
- 2) Should not purchase the products of animals ^{which were made up}
- 3) Strict rules & regulation.

MAN - WILDLIFE CONFLICTS

Conflict - Controversy.

Man-wildlife conflicts arise when wildlife starts

Causing immense damage & dangers to the ENV

Factors influencing Man-Animal Conflicts :-

- 1) Shrinking of forest cover - Industrialisation,
- 2) Human Encroachment into the forest area
- 3) Villagers put Electricity Wiring since elephants get injured & start violence
- 4) Cash Compensation paid by the government the damage caused by the wild animals is not enough.

ENDANGERED & ENDEMIC SPECIES OF INDIA

Endangered species :- Its Number has been reduced to a Critical level.

Eg White tiger

450 ^{plant} species } → Endangered species :
100 Mammals } in India
150 Birds }

FACTORS AFFECTING ENDANGERED SPECIES :-

- 1) Pollution
- 2) Over-Exploitation [Over usage]
- 3) Climatic Change.

ENDEMIC SPECIES :- Species Found only in a Particular Region

7000 plants } Endemic Species in
47000 other } India
Species }

FACTORS AFFECTING ENDEMIC SPECIES IN INDIA

- 1) Habitat loss
- 2) Fragmentation
- 3) Pollution.

CONSERVATION OF BIODIVERSITY:

Definition :- Yielding the greatest sustainable benefit to present generation & Maintaining it to meet the Needs of future generation

Factors affecting Biodiversity

- * Development Activities
- * Poaching of Wild Animals
- * Climate factors
- * Pollution

Advantages of Biodiversity Conservation:

- * Recreation & Tourism
- * Medicinal products
- * Life Supporting Systems on the Earth

4) Preserves genetic diversity

5) Commercial purpose :

Types of Biodiversity Conservation

1) In-situ Conservation [within habitat]

2) Ex-situ Conservation [outside habitat]

In-situ Conservation :- Protection of plants & Animals within the habitat

Methods of In-situ Conservation :-

1) Biosphere Reserves → More than 5000 sq. km

2) National park → Area 100 to 500 sq. km

3) Wildlife Sanctuaries → use to protect only wild animals

Advantages of In-situ Conservation

1) Cheap & Convenient Method

2) Life span of the species may get increased

Disadvantages

1): Large surface area is required

2): Maintenance is tough.

Ex-situ Conservation :- protection of plants & Animals outside the habitat.

Methods

1) National Bureau of plant genetic Resources [NBPGR]

2) " " " " Animal " " [NBAGR]

VALUE OF BIODIVERSITY

Biodiversity is Very much important for stable & to lead life on the Earth

It is broadly classified into two types namely :-

→ Direct Values

→ Indirect Values

Direct Values

1) Consumptive Use Value

2) Productive Use Value

Consumptive Use Value :- Biodiversity Products are harvested & Consumed directly.

Ex : Food, drug [Medicinal products] & fuel etc.

Food : Large number of wild animals were consumed by human beings as food.

Drug : 70% of Medicines were derived from plants.

Fuel : Fuel like Coal, petrol & Natural gas are also products of biodiversity.

Productive Use Values :- Biodiversity products were used for Commercial purpose (Trade)

Ex :- Wood → Plywood, Paper Industry

Cotton → Textile Industry

Fruits → Fruits Industry

INDIRECT VALUES

- 1) Social Value
- 2) Ethical Value
- 3) Aesthetic Value
- 4) Optional Value.

Social Value :- These values are associated with social life, religion & spiritual aspects.

Holy Plants :- Tulsi, Lotus

Holy Animals :- Cow, Snake

Ethical Value :- Ethical value means that a species may (or) may not be used, but its presence will add value to the biodiversity.
"Live & Let to Live"

Aesthetic Value :- The presence of flora & fauna may give aesthetic [beautiful] appearance to the Nature.

Optional Value :- The values of the biodiversity products are presently unknown & need to be known
Ex ^{yet} Searching the Medicine for AIDS

BIO DIVERSITY AT LOCAL, NATIONAL & GLOBAL LEVEL

Biodiversity at Local level :-

- 1) Point Richness
- 2) Alpha Richness
- 3) Beta Richness
- 4) Gamma Richness

Point Richness : Species found at a single point

Alpha Richness : Species found in a small homogeneous area. [same]

Eg : Arctic region - polar bears.

Beta Richness : Rate of change in species across different habitats

Forest :- Wild animals such as Lion, tiger etc

River :- Fish, Aquatic plants, Crocodile, Frog etc.

Gamma Richness :- Rate of change in species across large area.

Biodiversity at National level :-

→ India is Second largest Nation containing 5% of World's Biodiversity & 2% of Earth Surface

→ 10th Rank - Plant richness of the world

→ 11th Rank - Endemic species.

→ 6th Rank - Agricultural Crops.

Medicinal Value :- ^{Medicinal} 2000 plants are cultivated in India
Commercial Value

- Sandal wood - High Commercial Value.
- Indian Tobacco - high Nicotine Content.
- Mushroom - Exported to ^{other} Countries
- Ornamental plants, flowers & fruits - Value increase by decade to decade.

BIODIVERSITY AT GLOBAL LEVEL :-

- Living Species in the World - 2.5 million
- 1.5 Million Species found & Scientific Names were given
- 0.5 % increase in species date

INDIA AS A MEGA DIVERSITY NATION.

Mega → large (as) inside

Diversity → Variety of plants & animals.

- India is one among the 12 Mega diversity countries in the world.
- 89,450 Animals
- 47,000 plant species
- 33% loss in biodiversity.

Plant diversity in India

5000 → Flowering plant species

166 → Aop plant species

Marine diversity in India

340 → Coral species

Mangrove & seagrasses are also found in our country

Agro-biodiversity :-

30000 to 50000 → Varieties of rice, Mango, turmeric, ginger etc.

Animal biodiversity :-

75000 → Animal species

5000 → Insects

(X) Red data Book :- It consist of list of Endemic & Endangered species.

44 → plant species Endangered.

54 → Animal species Endangered.

HOT SPOTS OF BIODIVERSITY: Many areas have been reduced to less than 10% of their Original Vegetation - geographic areas which poss high endo sp

Criteria For Recognizing Hot Spots

- 1) Site is under threat
- 2) Contain important plants

3) Have significant percentage of specialised species

Hot spots in India :-

Eastern Himalayas - Indo-Burma region
Western ghats - Sri-Lanka region

THREATS TO BIODIVERSITY

Threat → Harm.

Threat to biodiversity is nothing but the disturbance occur in the biodiversity.

Causes for loss of Biodiversity :-

1) Habitat loss

→ Deforestation

* Forest and grassland have been converted into settlement (or) development areas for industrialization, dams etc.

→ Destruction of Wetlands

It has been caused because of

draining, filling & pollution

→ Habitat Fragmentation

→ Wild animals & Birds are vanishing because of this Habitat fragmentation

Fragmentation → Smaller parts

Advantages

- 1) Special Care & attention
- 2) Security - high level
- 3) Endangered species may be protected since life span may be increased

Disadvantages

- 1) Expensive
- 2) Freedom is lost
- 3) Animals cannot survive in that environment

2.8 FOOD CHAIN

- ✧ A food chain may be defined as, “the transfer of energy and nutrients through a series of organisms with repeated process of eating and being eaten”.
- ✧ In an ecosystem, all the organisms are linked together with one another by food relationship.
- ✧ Each organism living or dead is potential food for some other organism.

2.9 FOOD WEB

- ✧ Under natural conditions, the linear arrangement of food chains hardly occurs & these remains connected interconnected with each other through different types of organisms.
- ✧ Interlocking pattern of several interlinked food chains is termed as FOOD WEB.

2.11 NUTRIENT CYCLES

- ✧ Nutrient cycles involve storage and transfer of nutrients through different components of the ecosystem, so that the nutrients are repeatedly used.

- ✧ The cyclic movements of chemical elements of the biosphere between the organisms and environment are referred as “**BIOGEOCHEMICAL CYCLES**”

Gaseous cycle: Those elements in which the reservoir is the air or the oceans (via evaporation).

Gaseous cycles include those of Carbon, Nitrogen, Oxygen, Carbon, and Water.

Sedimentary cycle: Those elements which are received from the Earth's crust. Sedimentary cycles include those of iron, calcium, phosphorus, and other more earth bound elements.

2.11.1 NITROGEN CYCLE

- ✧ Nitrogen is crucial for all organisms
- ✧ Nucleic acids
- ✧ Proteins
- ✧ Chlorophyll
- ✧ Nitrogen- 78% in Atmosphere
- ✧ N₂ is very stable and must be broken apart by organisms, combined with other atoms into a usable form.

- ✧ Nitrogen cycle completes in 5 steps:

1) Nitrogen Fixation

Conversion of N₂ → NH₃

- ✧ Combustion, volcanic action, Lightning, Industrial processes (making fertilizer). Bacteria (Azotobactor, Clostridium, Nostoc etc.)

2) Nitrification

Conversion of NH₃ → NO₃

Soil bacteria convert in a two step process.

3) Assimilation

Roots absorb NH₃, NH₄, or NO₃ and incorporate them into nucleic acids and protein.

4) Ammonification

Amino acids and nucleotides are broken down into waste products NH₃ or NH₄

5) Denitrification

The reduction of NO₃ to N₂. Denitrifying bacteria return some of the nitrogen to the atmosphere

Environmental pollution

Pollution - Definition

"The Unfavorable alteration of our Surroundings" is termed as pollution.

Types of pollutants :-

Biodegradable pollutants → decompose easily

Non-Biodegradable - decompose slowly

Types of pollution

- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

Noise pollution : "Unpleasant sound is termed as Noise which cause discomfort to all living beings."

Sources of Noise

- Industrial Noise
- Transport Noise
- Neighbourhood Noise

Industrial Noise :- It is Nothing but the Noise of Machines of different Industries, Factories etc

-> Industrial Noise has damaged the hearing of about

Millions :

Eg :- In Steel Industries, the Exposed Noise level is of 112 dB for 8 hours

Transport Noise :- It includes the Road Traffic Noise, Rail Traffic Noise & Air Craft Noise

-> The Main Source of Transportation Noise is because of the Increase in Diesel Engines

-> Delhi, Kolkata & Bombay have high Noise level of 90 dB.

Neighbourhood Noise :-

-> It includes Noise from House hold gadgets & Community Sound.

-> Example : Sound from TV, radios, telephones etc

Effects of Noise pollution

1) Contraction of blood vessels

2) Nerves break down

3) Leads to tension

4) Mental distress

5) Heart ailment & Neurological problems

6) Psychological & pathological disorders

7) Ultrasonic sound can affect the digestive, respiratory & internal ear

8) Brain also affected by high sound.

9) It has been recently found that blood is also thickened

10) Hearing impairment

Control Measures of Noise pollution

1) Oiling :- Proper oiling will increase the smooth functioning of a machine, thus reducing the noise

2) Planting trees -> leaves have the tendency to absorb the sound

3) Source Control -> It is important to do some modification in the pollutants which cause noise pollution

Eg :- design changes, reducing the working time of machine

4) Transmission path intervention :- Providing the noise absorbent material along the path

Example Glass doors, windows etc

5) Receptor Control :- People who receive high level sound should use Ear plugs.

6) Should implement Strict Rules & Regulations Near by Residential area, School zone, Hospital zone. Noise level should be reduced.

Soil POLLUTION

Def :- The Contamination of soil by human & Natural activities.

Types of SOIL POLLUTANTS

- 1) Industrial Waste
- 2) Urban Waste
- 3) Agricultural practices
- 4) Radioactive Waste products
- 5) Biological agents

Industrial Waste :- It includes the wastage

from different Industries such as Steel, Plastic, Chemical, Sugar factories, oil refineries etc.

Effect :- It alters the physical & Biological properties of soil

Urban waste :

→ Includes both Commercial & domestic waste

Domestic waste :- It includes food waste, clothes, plastic, glass bottles etc

Commercial waste :- It includes the waste from commercial buildings

Agricultural practices :- It happens because of using chemical fertilizers & pesticides

Radioactive pollutants :- It includes the substances from explosions of radioactive products.

Ex Ruthenium, Iodine, Barium

Biological agents :- It includes the excreta from human, animal & birds

Control Measures of Soil pollution .

- 1) ^{Have to} Control the population growth
- 2) Should minimize the rate of urbanization
- 3) Soil Erosion can be controlled by planting trees
- 4) proper dumping
- 5) Usage of natural fertilizers & pesticides should be increased
- 6) Awareness programs
- 7) Hygienic condition

- 8) Usage of Recycling products should be Encouraged
- 9) Toxic Chemicals should be banned.

(X.) SOLID (OR) SOIL (OR) WASTES MANAGEMENT

→ It can be controlled by proper dumping of the waste. If the dumping is not properly done since it may cause problems related to health.

→ Solid waste types

- 1) Domestic waste } urban waste
- 2) Commercial waste }
- 3) Construction waste
- 4) Biological waste.

PROCESS OF SOLID WASTE MANAGEMENT

Solid waste generation

↓

Collection of waste

↓

Transportation

↓

Storage

↓

Segregating [splitting]

↓

disposal

- 1) Land Fill
- 2) Incineration
- 3) Composting

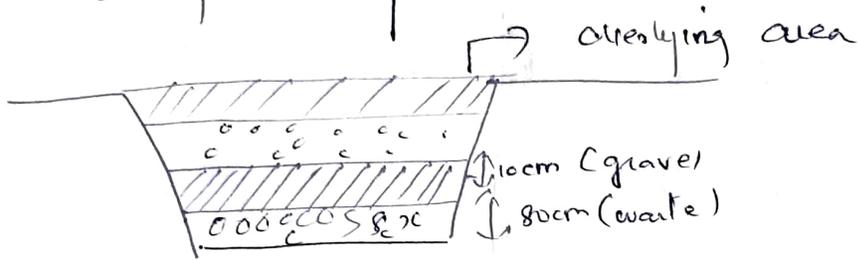
(7)

Landfill :-

→ Wastage are dumped in alternate layers of 80 cm thickness & it is covered with 10 cm thickness of Earth fill [Gravel] by proper

Compaction

→ By using landfill method both the waste (ie) Biodegradable & Non-Biodegradable can be dumped together



Advantages :-

- Simple & Cheapest Method.
- Segregation Not required.
- Overlying area can be used for some other purpose
- Skilled labour not required

Disadvantages

- If dumping is not properly done it will become the breeding place of Mosquitoes. Since it causes infectious disease
- dumped waste may form Methane gas since it leads to fire hazard

→ Transportation cost is high

Incineration (or) thermal process :-

→ It involves the process of detoxification [removal] of all combustible pathogens.

Step: 1 Solid wastes are dried (ie) ^{Removing the} water content

Step: 2 Wastage should be segregation as combustible & Non-combustible products

Step: 3 Combustible products alone should be introduced into the furnace.

Step: 4 : left out non-combustible products may be used for recycling.

Step: 5 At ~~the~~ too high temperature the furnace should be operated.

Step: 6 : Solid wastes are converted into ashes which may easily disposed by the landfill.

Step: 7 Heat produced in the Incinerator can also be used to generate Electricity :-

Advantages

- Transportation cost is high
- Hygienic method
- Skilled labour required
- Requires only smaller space

MARINE POLLUTION

def: disposing the waste in the water bodies may cause hazards to human being as well as aquatic life.

Sources of Marine pollution :- coral reefs;

- 1) Dumping the waste
- 2) oil pollution.

Dumping the waste :-

→ It happens because of disposing the waste products from industrial, agricultural etc.

→ Improper dumping of waste products may also affect the aquatic life

Oil Spilling :- Oil enters water from cracks of oil tanks, cleaning of fuel tanks, accidental spillage etc.

Effects of Marine pollution :-

→ oil pollution cause damage to marine flora & fauna

→ It may decrease the temperature of the waterbody thus causing hypothermia in birds

→: Oxygen level of the water bodies will be drastically decreased

→ It may generate 3MW of power. If 300
of wastage is burnt.

Disadvantages

- 1) Capital & operating cost is high.
- 2) formation of smoke may cause pollution

COMPOSTING:

→: Converting Organic waste into fertilizing Manure.

Step: 1: Only organic waste products should be separated

Step: 2 It is dumped in the trenches [pits] of 1.5 m thick & it is covered with 20 cm thick of Earthfill

Step: 3: Antinomycetes are introduced with the wastage for quick decomposition

Step: 4: With 2 to 3 days, biological action will be started thus by increasing the temperature about 75°C & finally the wastage are converted as Natural Manure. which can be used for plant growth.

Advantages

- 1) Industrial wastage can also be treated
- 2) Recycling
- 3) disposal cost can be reduced

→ If abc decreases the rate of growth of photosynthesis

→ Since because of waste products accumulated in the Intestine may produce Benzene's hydrocarbons, which consumed by the human beings may cause cancer.

Control Measures of Marine Pollution:

- 1) By creating awareness among people
- 2) Local Communities must be involved in protecting the resources
- 3) Economic incentives should be offered for conserving the resources
- 4) Urban growth near the coastal areas should be minimized
- 5) Pollution control instruments should be used.

METHODS OF REMOVAL OF OIL:

1) Physical Methods

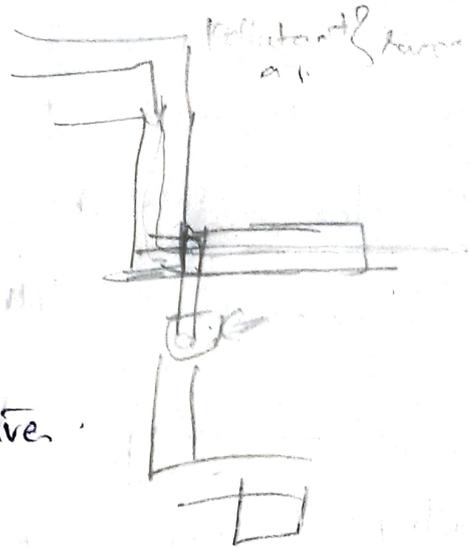
i) Skimming Method

oil ~~can~~ be removed: \rightarrow By using suction apparatus

⇒ Oil can also be absorbed using a suitable absorbing material like polyurethane foam.

Chemical Method

- Dispersion
- Emulsification
- Using chemical additive.



Air pollutant

Air pollution is the presence of one or more contaminants in the atmosphere which are injurious to living organisms.

Sources of Air pollutant

Natural Source

Eg. Volcanic Eruption, Earth quake, pollen grains, forest fire etc.

Man made Source

Thermal power plant, Vehicular Emission, agricultural activities etc...

Classification of Air pollutant

Primary pollutant :- directly pollute the air

Secondary pollutant :- Indirectly pollute the air

AIR POLLUTANTS - TYPES

Carbon monoxide [CO]

- Colourless
- Odourless
- poisonous



Causes

- Cigarette Smoke
- Incomplete burning of fossil fuel

Human effects

- Anemia
- Head aches
- Coma
- Reduces the oxygen supply.

Environmental effects

- Increases the global temperature

Nitrogen di oxide (NO₂) → $\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3$

- Irritating gas
- Cause photochemical smog

Causes :

- Vehicular Emission
- Burning of Fossil Fuel

Human effects

- Lung irritation

Environmental Effects

- Corrode Metals

Sulphur-di-oxide (SO₂)

- Colourless
- Irritating gas

Causes :-

- Burning of coal
- Industrial Effluents

Human effects

- Breathing problem

Environmental Effects :- Affect the aquatic life

Suspended particulate Matter (SPM)

→ Microscopic (8) liquid Matter suspended in the Earth's atmosphere

Causes

- Volcanic Eruption
- dust storms
- Burning of fossil fuel
- Industrial process
- grassland fires

Human effects

- Asthma
- Chronic disease
- premature death
- Respiratory problems.

Environmental effects

- Acidic deposition
- affect the aquatic life

Ozone (O₃)

- Natural gas composed of three atoms of Oxygen.
- Blue in colour & has strong odour

Causes : → Ozone is not directly emitted into the atmosphere but forms when oxides of nitrogen (NO_x) & Volatile Organic Compounds (VOCs) are in the air & sunlight is present

Human effects

- Skin Cancer
- Cataract
- DNA damage
- Coughing
- Throat irritation

Environmental effects

- Climate change
- Affects the Marine Ecosystem
- Ozone depletion

Hydrocarbons

- Simplest Organic Compounds
- Found in Crude oil & Natural gas
- It has been branched as cyclic molecules.

Causes

- Vehicular Emission
- Improper Ignition timing
- defective Catalytic Converter
- Lean Fuel Mixture

Human effects.

- Respiratory problems
- Neurological problems

Environmental effects

- Microbial degradation
- Increase the salinity
- affect the aquatic life

Some of the Organisms like Bacteria (&) other Microscopic organisms will not be decomposed if it is ~~dey~~ accumulated in the acid rain.

Reduce the rate of Photosynthesis.

Control Measures

- ① Avoid Burning the Fossil Fuel
- ② Pollution Control Equipments to be used to absorb the toxic gases which cause acid rain
- ③ Liming of lake & soil should be done

Control Measures of AIR pollution :

Source Control :-

- 1) Use Unleaded petrol
- 2) Reduce the Number of private Vehicles. Some Mass-transport System should be Encouraged.
- 3) Wastage should be disposed outside the city.
- 4) Afforestation should be improved.
- 5) Pollution Control Equipments to be used.
- 6) Strict rules & regulations should be implemented

WATER POLLUTION

Alteration in physical, chemical & Biological characteristics of water is termed as Water pollution.

Sources of water pollution:

1) Infectious agents : Bacteria, Virus & Parasite worms

Human Sources :- Human & Animal waste

Effects : Variety of diseases.

2) Dissolved oxygen :- Degradation of Manure may decrease the dissolved oxygen content & since it may fix the Anaerobic condition & the aquatic life may be affected a lot.

3) Inorganic Chemicals :

Source :- Surface runoff & Industrial Effluent

Effects :-

1) Lowers the crop yields

2) Skin Cancer

3) May affect the aquatic life

Organic Chemicals : oil, gasoline etc

Sources

- 1) Industrial effluents
- 2) Surface runoff

Effects

- 1) Nervous system damage
- 2) affect aquatic life.

Plant Nutrients: Ammonium, Phosphate:

Causes : Sewage, Manure, Fertilizers

Effect: Lowers the Oxygen Carrying Capacity
of the blood.

6. Sediments : silt, soil etc

Sources : Land Erosion

Effects:

- 1) Lowers the photosynthesis level.
- 2) disturbs the aquatic life

7. Radioactive Materials :- Radon, Uranium

Sources: Nuclear power plant & Mining

Effect: Causes

CONTROL MEASURES OF WATER POLLUTION :-

- Industries should be located far away from the Residential Area
- Afforestation should be improved, since soil erosion can be minimized.
- Awareness should be created among people
- Recyclable products to be used
- Water tests should be carried out periodically
- Wastage to be disposed only after the proper treatment.

Sewage Treatment process

1) Preliminary Treatment

→: Coarse solids ^{↳ [Large particles]} were removed using Mesh & Screens

2) Primary Treatment: Organic & Inorganic solids were removed, by adding coagulants like Alum, Ferrous sulphate etc

Secondary Treatment :-

- > Biodegradable Organic impurities are removed by aerobic bacteria
- > done by using trickling filter

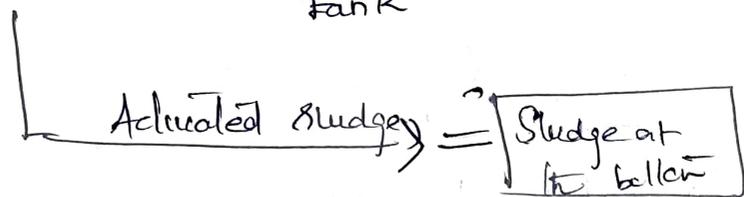
Trickling filter:

- > It is filled with coarse rock
- > Sewage is sprayed over the rock
- > Microorganisms grow on the rock may absorb the sewage as food

2) Activated Sludge Process

Contains aerobic bacteria which can easily oxidise the organic impurities.

Sewage \rightarrow Aeration tank \rightarrow Sedimentation tank



3) Tertiary Treatment : After the ^{Secondary} treatment of it

may contain BOD, [Biological oxygen demand] which can be removed by using tertiary treatment, by adding lime & phosphates

Disposal of Sludge

- 1) By using landfill, Incineration & Composting
- 2) dumping

9) THERMAL POLLUTION

When excess heat is added to water, it may cause damage to living beings

Causes

- 1) Nuclear power plants
- 2) Coal-fired power plant
- 3) Industrial Effluents
- 4) Domestic Sewage
- 5) Hydro-electric power.

Nuclear power plant:

-> Effluents from power plant are discharged at 10°C , higher than the receiving water which will affect the aquatic life

Coal-fired power plant:

-> Effluents from the power plant decrease the dissolved oxygen content, since it kills the aquatic life

Industrial Effluents :- Industrial effluents discharged

in water may increase the temperature of water since it may kill the aquatic life

Domestic Wastage : It may fix the anaerobic

condition since, aquatic life is greatly affected

Soil Erosion

Pesticides

Construction works.

Effects of thermal pollution

Reduction in dissolved oxygen

Increase in toxicity

Interference with biological activities

Interference with reproduction

Food storage for fish

Control Measures

Cooling tower : By using condensers the heat air emitted is converted into water, which may be recycled

→ Two types

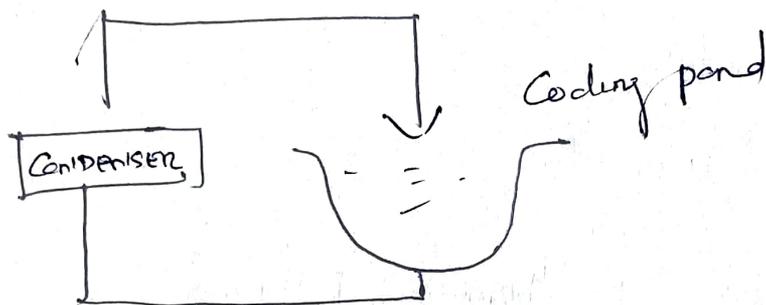
a) Inlet Cooling tower.

b) Dry Cooling tower.

2) Cooling ponds :-

→ Simplest Method

→ By using Condensers the heat is dissipated to the atmosphere



Spray ponds : Water is sprayed through the nozzle since heat gets dissipated in the atmosphere

Artificial lake :

→ Manmade water bodies

→ Heat water is discharged at one end & after some time water may be cooled since the same water can be withdrawn for some other purpose

FORMATION OF SMOG

Smog \rightarrow Smoke + fog

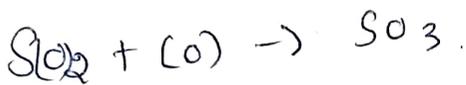
\rightarrow Substances, when mixed with the right amount of sunlight & heat turns as smog

Types :-

\rightarrow London smog :-

\rightarrow Coal smoke + fog

\rightarrow Contains SO_2 + SO_3 + humidity



Health effects :-

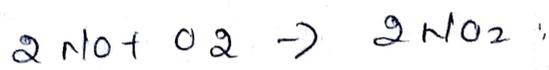
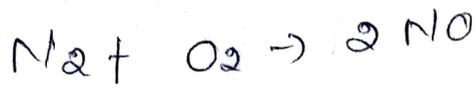
- 1) Pneumonia.
- 2) Tuberculosis.
- 3) Heart failure.
- 4) Bronchitis.
- 5) Respiratory problem.
- 6) Eye Irritation.

Environmental Effects :-

- 1) Reduce the visibility
- 2) Leads to thermal inversion [ground temperature lower than the atmosphere temperature]
- 3) Produces acid rain

Los Angeles Smog

→ Formed by the combination of the following gases
 NO , NO_2 , CO_2 , H_2O , CO_2 , SO_2 & Unburnt hydrocarbon particles.



Health effects

- Irritates, Nose, Throat & Eye
- Cause lung damage.

Environmental effects

- produces acid rain
- damage plants

PAN [Peroxyl acetyl nitrates]

- Oxidant ^{Stable} More than Ozone:
- Can be transported to long-range than Ozone.
- Secondary pollutant present in photochemical smog
- Serves as a carrier for oxides of Nitrogen into rural regions

Health effects of PAN:-

- Respiratory pneumonia.
- tuberculosis.
- Chronic infection.

● Environmental effects of PAN

1) Cause damage to vegetation

Acid Rain:

→ Acid rain is a rain (or) any other form of precipitation that is unusually acidic, meaning that it possesses elevated level of hydrogen ions

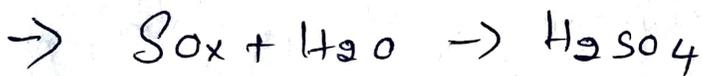
[low pH]:

→ Gases like Nitrogen oxides & Sulphur di-oxide react with the tiny droplets of water in clouds to form Sulphuric & Nitric acid.

Formation of Acid Rain :-

→ Acid rain is caused by the release of the gases SO_2 [Sulphur-di-oxide] NO_x [Nitrous oxides].

→ Main source of NO_x emission is from vehicles & fuel combustion.



→ These reactions take hours (or) even days during which polluted air may move hundreds of kilometres

→ When mist (or) fog droplets condense they will remove pollutants from the air & become

More Strong than Acid.

Effects of Acid Rain on human beings :-

- Human skin is directly exposed in the acid rain, since it may cause some infectious (or) skin diseases due to chemical reactions
- Lung related problems
- Asthma
- Premature death.

Effects of acid rain on buildings:

- permanent alteration of stone surfaces by sulphation, where the exposed surfaces of buildings are washed away.
- Corrodes the metals
- In addition to the atmospheric effect some of the structures like foundation & pipe submerged in the acid rain may also be corroded easily.

Effects of Acid Rain on Ecosystem

- Aquatic life will be damaged

Water Pollution:

- Major forms of H₂O pollution

* Disease-causing agents.

* Oxygen-demanding wastes. (organic wastes)

* water-soluble inorganic chemicals

* Inorganic plant nutrients

* organic chemicals.

* Sediments / suspended matter.

* Radioactive substances.

* Heat.

Sources:

- Industrial effluents.
- Domestic sewage.
- Fertilizers + Pesticide from agricultural lands.

kw: Ground H₂O Pollution; Ganges Pollution.

Mgmt of Municipal Sewage:

1) Sewer: The pipeline / conduit carrying the sewage.

2) Sewage: It is the liquid flowing in a sewer.

3) Sullage / Grey water: Waste water gen. from kitchens + bathroom.

4) Sanitary / domestic sewage: " " + from residential area.

5) Storm drainage: H₂O entering a sewer as a result of rainfall.

6) outfall sewer: The main sewer carrying the entire waste H₂O collected from an area to the pt of disposal / to the treatment plant.

7) Sewerage: The art of collection, treatment and disposal of sewage.

8) Dry weather flow: The qty of sewage flowing in the sewer during summer seasons, with only sanitary sewage ∴ there's no rain in this season. ~~This~~.

BOD: Biochemical oxygen demand: It is the amount of O_2 required for the

Treatment of sewage: biological decomposition of org. matter in the presence of H_2O .

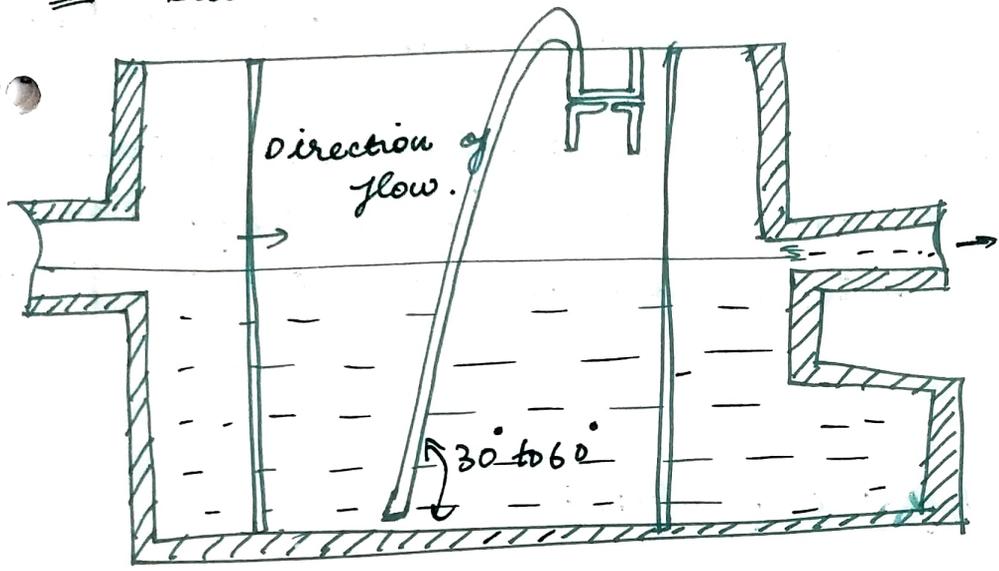
The sewage treatment mtds can be classified into.

- 1) Primary treatment.
- 2) Secondary "
- 3) Tertiary "

1) Primary treatment:

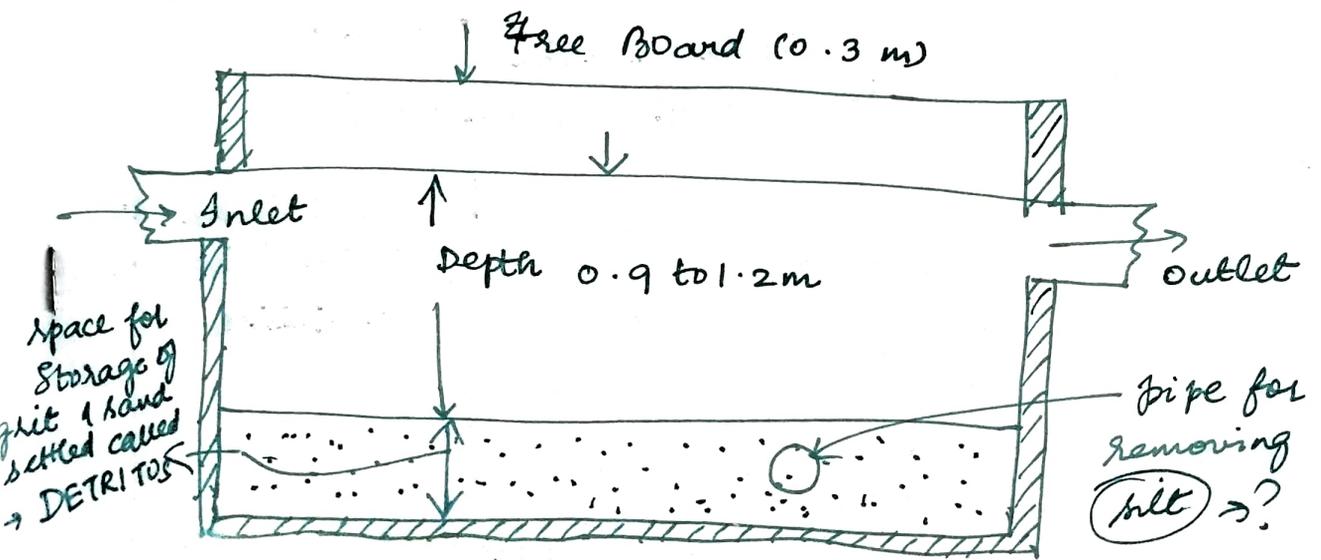
→ SCREENS: (To remove rags, wood pieces etc.)

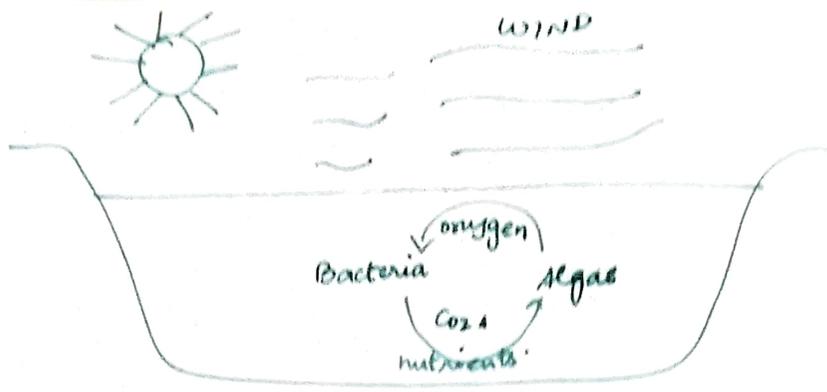
eg: Bar screens.



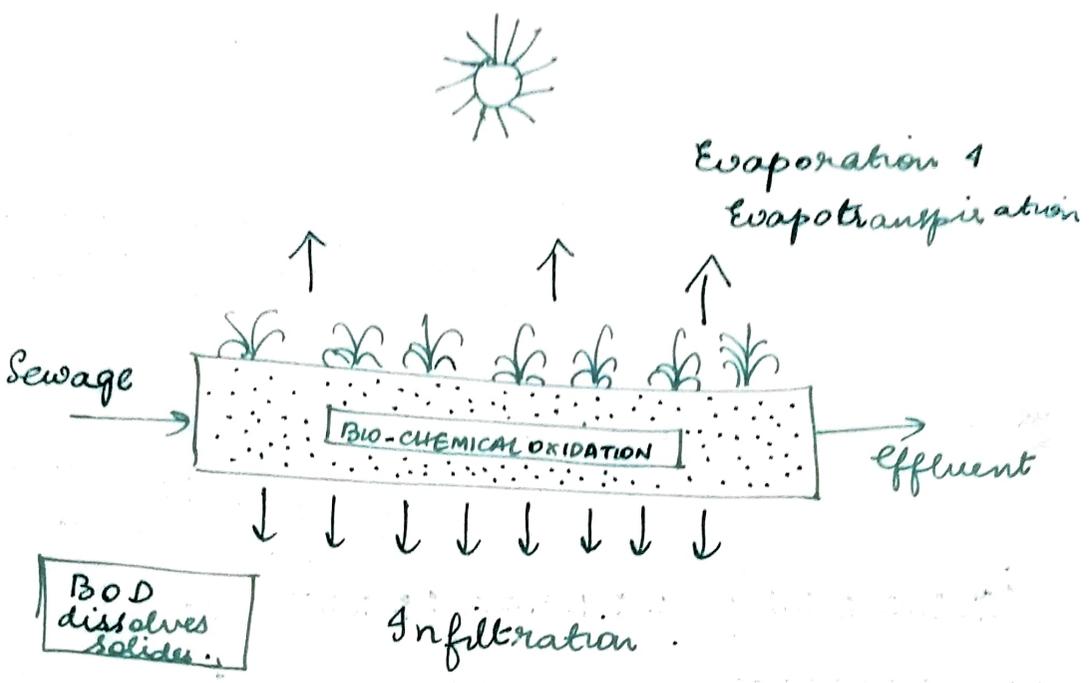
2) Grit chamber: For removing inorganic solid suspended particles in the sewage such as grit & debris.

This is done by reducing the velocity of flow in an enlarged channel where the particles get settled out.





Constructed wetlands :



OSMOSIS:

- Tinnitus
- Acoustic Trauma.
- Temporary threshold shift

Oil Pollution:

Types → Industrial wastes
 ↓ ↓ ↓ → Urban wastes
 ↓ ↓ ↓ → Agricultural Practices

Biological agents
 Radioactive Pollutants

mtds of oil removal:

Skimming

chemical

dispersion
 sorption
 mtds using chemical additives

Organic Industry

- apt paper
- Rubber industry (cl)
- oil refineries
- Antibiotics
- Synthetic drugs
- Distillery
- Organic chemical Industry

Inorganic Industry

- Thermal Power Plants
- Steel mills
- Cotton industry
- Metal Plating
- Iron foundry
- Pesticides
- Acids
- Tanneries (Co, Cr)
- Explosives

Marine Pollution

Source:

- 1) Dumping the wastes
- 2) oil pollution of marine life

Effects of marine Pollution

(birds, hypothermia)

Control measures of Thermal Pollution:

- 1) Cooling Towers
- a) Wet cooling tower
- b) Dry " "
- 4)
- 2) Cooling Ponds
- 3) Spray Ponds.
- 4) Artificial lakes.
- 5)

Human activities that introduce Thermal Pollution:

- 1) Industries & power plants may use H_2O to cool machinery & then discharge the warmed H_2O into a stream.
- 2) H_2O temperature rises when trees & tall vegetation providing shades are cut down.
- 3) Soil erosion by construction, removal of stream-side vegetation, poor farming practices, over grazing \rightarrow \uparrow the amount of SUSPENDED SOLIDS IN THE WATER.

- 4) Thermal pollution can also occur through earthquakes.

3) Hazardous wastes

chemical manufacturing companies, paper mills, radioactive substances, petroleum refineries, smelters, radioactive substances, biological wastes & other industries.

Effects of solid waste mgmt:

- 1) From organic domestic waste
 - 2) Exposure to hazardous waste
 - 3) Waste from agriculture & industries.
 - 4) Disposal of hospital & other medical waste.
 - 5) From the waste treatment & disposal sites. (Should be far from human settlement).
 - 6) Recycling.
- Impacts on health.
- 

Diseases: (cyanides, mercury & polychlorinated biphenyls)

Occupational hazards associated with waste handling:

1) Infections

- Skin & blood infections (due to contact with infected wounds)
- Eye & Respiratory infections due to dust.
- Intestinal infections that are transmitted by flies feeding on the waste.

2) Chronic diseases

- Incineration operators are at risk of chronic respiratory diseases, including cancers resulting from exposure to dust & hazardous compounds.

3) Accidents

- Bone & muscle disorders due to carrying of heavy containers.

Process of solid waste mgmt (or) process of prevention
 Solid waste mgmt generation in urban areas/
 waste shed mgmt.

Flow chart:

Solid waste generation



collection of waste



Transportation



Storage



Segregation of wastes



Disposal methods.



Landfill



A site for the disposal of solid waste in which refuse is buried by layers of dirt so as to fill in or reclaim low-lying ground.



Incineration



Composting



Meaning of

Leachate: Sol. from leaching, containing contaminants picked up by the soil through leaching.

Leach: To dissolve out

- Soluble constituents from/by percolation.
- To cause H₂O/other liquid to percolate through something.

Sanitary landfill.

Percolate:

To cause a liquid to pass through a porous body;

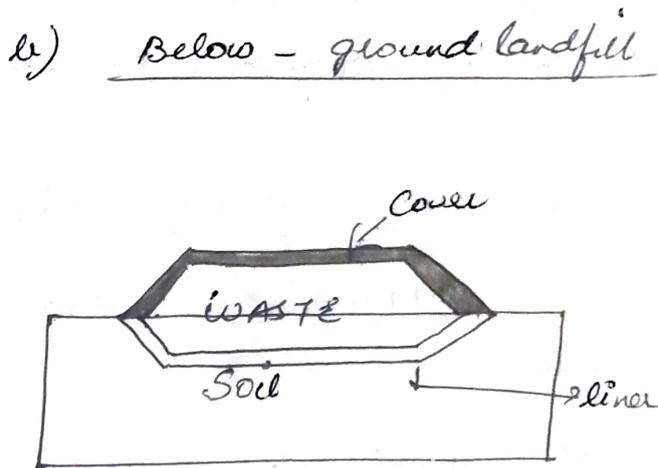
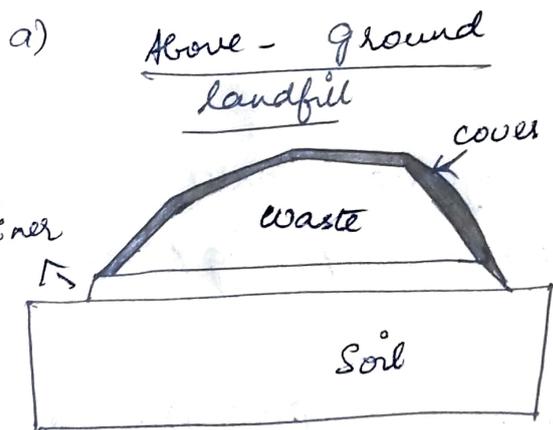
porous body;

filter.

manure by biological action.

[The act of disposing rubbish & waste]

Land fill diagram:



c) Above + below ground landfill:

Incinerator:

kw: cinder → ?

Composting: To know:

→ Actinomyces for active decomposition.

→ Powdery brown coloured odourless mass known as →

HUMUS has
↳ fertilizing value, used for agriculture.

- water retention + ion-exchange capacity of the soil ↑.

- Source reduction

- Reuse, Recycle & Reduce.

COMPOSTING: Decomposition of organic wastes.

kw: Parameters controlling the composting process are,

- a) Available carbon to nitrogen. (C:N) ratio.
- b) Moisture
- c) Oxygen &
- d) Temperature.

Carbon & Nitrogen	moisture	O ₂ Temperature
<p>→ C → as energy source for the micro-organisms.</p> <p>→ N → for microbial population</p> <p>→ Typical, recommended C:N ratios for Composting MSW are 25:1 to 40:1 by weight.</p> <p>kw: shredding / grinding of wood to make the surface area smaller to ↑ availability.</p>	<p>- Balance b/w MICROBIAL ACTIVITY & O₂ SUPPLY.</p> <p>→ Aerobic</p> <p>→ Anaerobic.</p> <p>→ that 1 air flow.</p> <p>→ Minimum moisture content of 50-55% is recommended for high rate composting of MSW.</p>	<p>Linked by a common mechanism called →</p> <p><u>AERATION.</u></p> <p>↓ & ↓</p> <p>Replenishes O₂ supply Removes excess heat.</p> <p>Temperatures of 45-59°C provide the highest rate of decomposition</p> <p>Temperatures >59°C → reduces the rate of decomposition due to a reduction in microbial diversity.</p>

706 million gallons of waste oil enter the ocean every year (from land drainage & waste disposal)

Offshore drilling & production operations

oil spills: Kuo: Liquid Petroleum → into environment by vehicles, vessel/pipeline.

It happens on a large scale.

Sources: Crude oil released by tankers on land.

As oil spills, it floats on H₂O & prevents sunlight to pass thru' it.

FACTORS: (Temperature of H₂O; Amount of oil spilled; Types of beaches).

Kuo: PLUMAGE & fur of birds; breaks down the insulating capabilities of feather which makes them heavier, disallow them to fly & causes its death by

hypothermia → Body core temp. 35°C

Dolphins
Sea otters
fish.
} difficult to regulate body temperature.

tation

deforestation → 2nd largest anthropogenic source of
CO₂ release into the atmosphere.
(6-17%)

Water vapour flows ↓ by 4% due to deforestation

↓
change in CLIMATIC CONDITIONS.

Effects of deforestation:

- 1) loss of species: - 70% of plant + animal
species → HABITAT in forests
- species extinction
→ loss of medicinal
research.
- 2) Water cycle: (Trees' role).
- 3) soil erosion: Soil → loose → vegetation
growth
problems.

deforestation: (Awareness Programs).

low → water
vapour
climate change
→ Moistness of
soil (erosion)
→ species
extinction.
→ slash & burn
agriculture.
→ clearcut
tech.
→ Paper, wood.
→ global
warming
→ cash crops,
eg: coffee, soy.

Effects of deforestation:

After-effects of deforestation:

- Species Influenced.
- Habitat "
- water cycle "
- Global warming ↑
- soil erosion
- Rain fall "
- Less medicine for illness.
- Carbon cycle influenced.

Causes.

- construction
- crop growing
- Feeding land
- commercial purposes
-
-

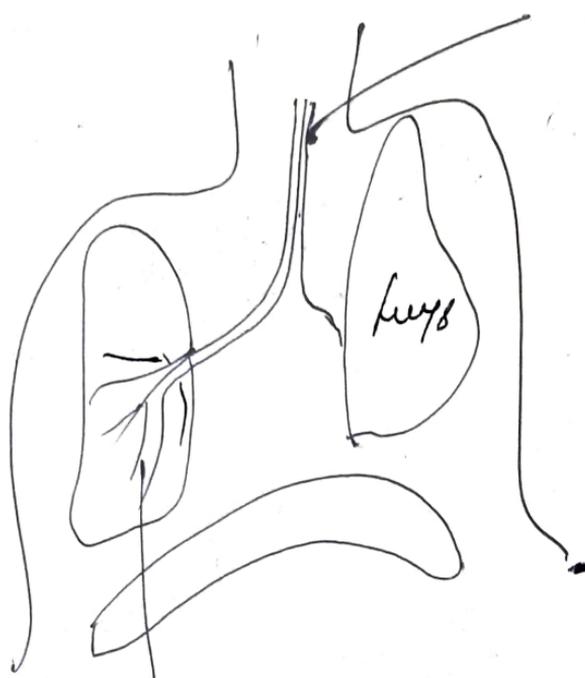
Effects.

- Soil erosion
- Flooding & drought
- Disturbance in the water cycle.

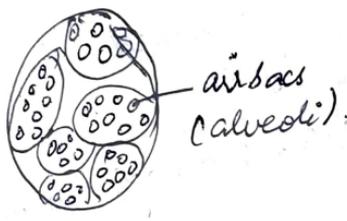
COPD:

char. by airway obstruction.
obstructive lung disease.
Symptoms, → shortness of breath, cough, sputum p.dn.

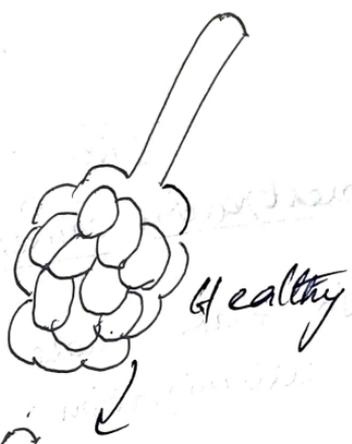
Chronic
BRONCH



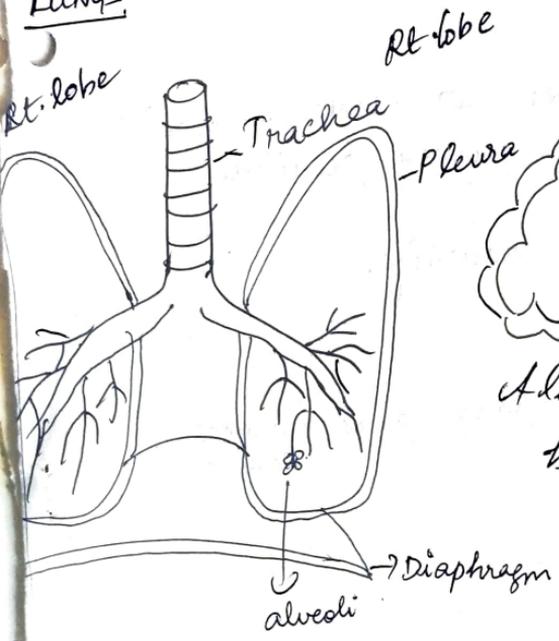
airways
bronchi



ALVEOL



LUNGS:



Alveolar membrane
breaks down.

- ca.
- Emphysema
- Hypoxia → low oxygen conditions.



↓ excess use of chemical fertilisers leads to run off of a gnd H₂O contamination.

Fish begin to die as O₂ levels fall

Inc'd growth of algae shading out other plants



The inorganic salts dissolved gnd H₂O eventually enter lakes, ponds & rivers

Increased nutrients absorbed by algae

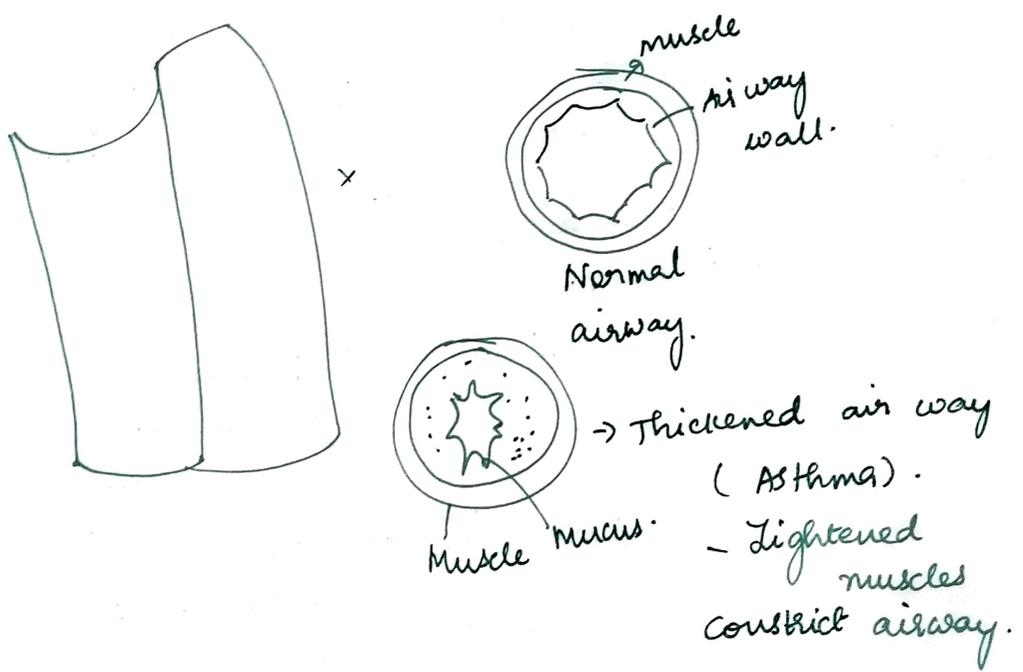
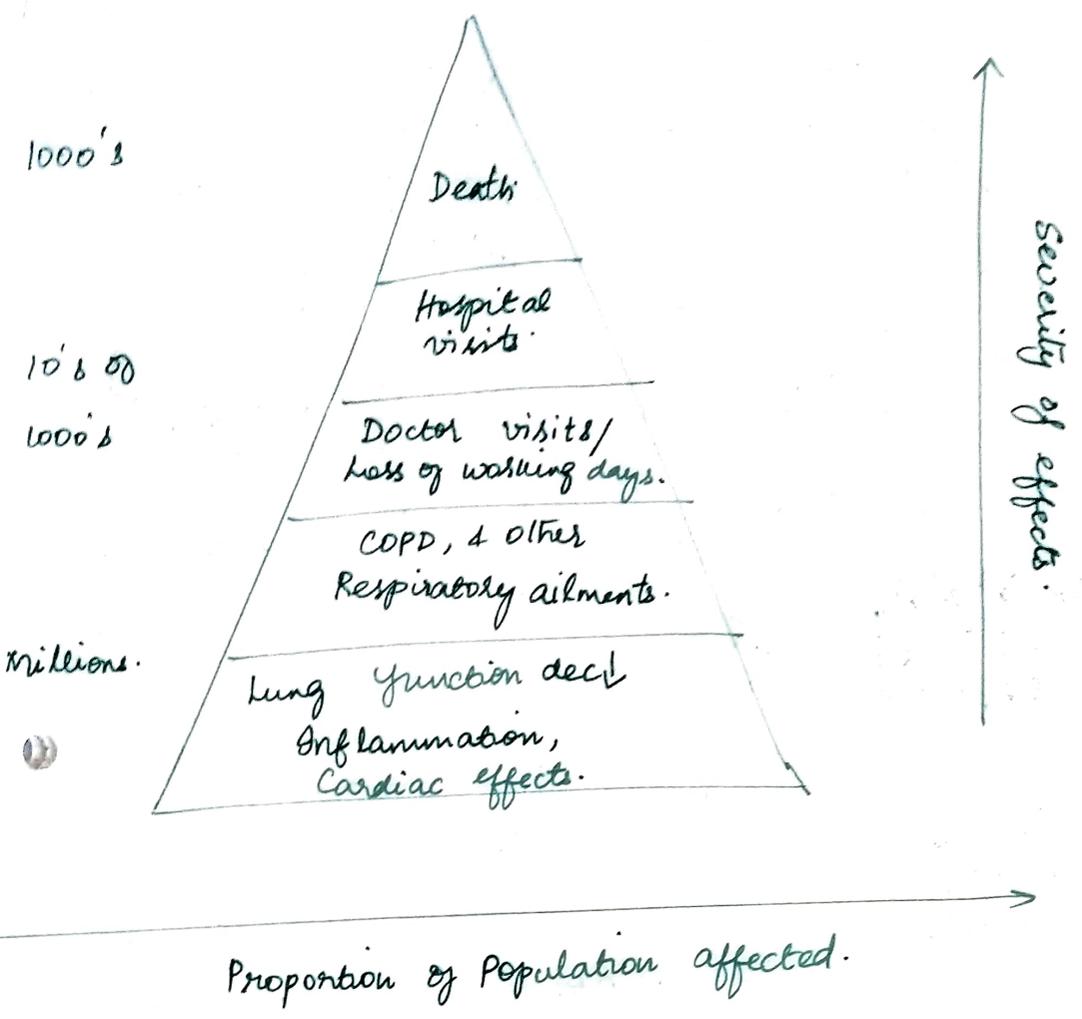
Inc'd decomposition of dead algae uses up O₂ in the H₂O

Deforestation causes: slash & burn agriculture

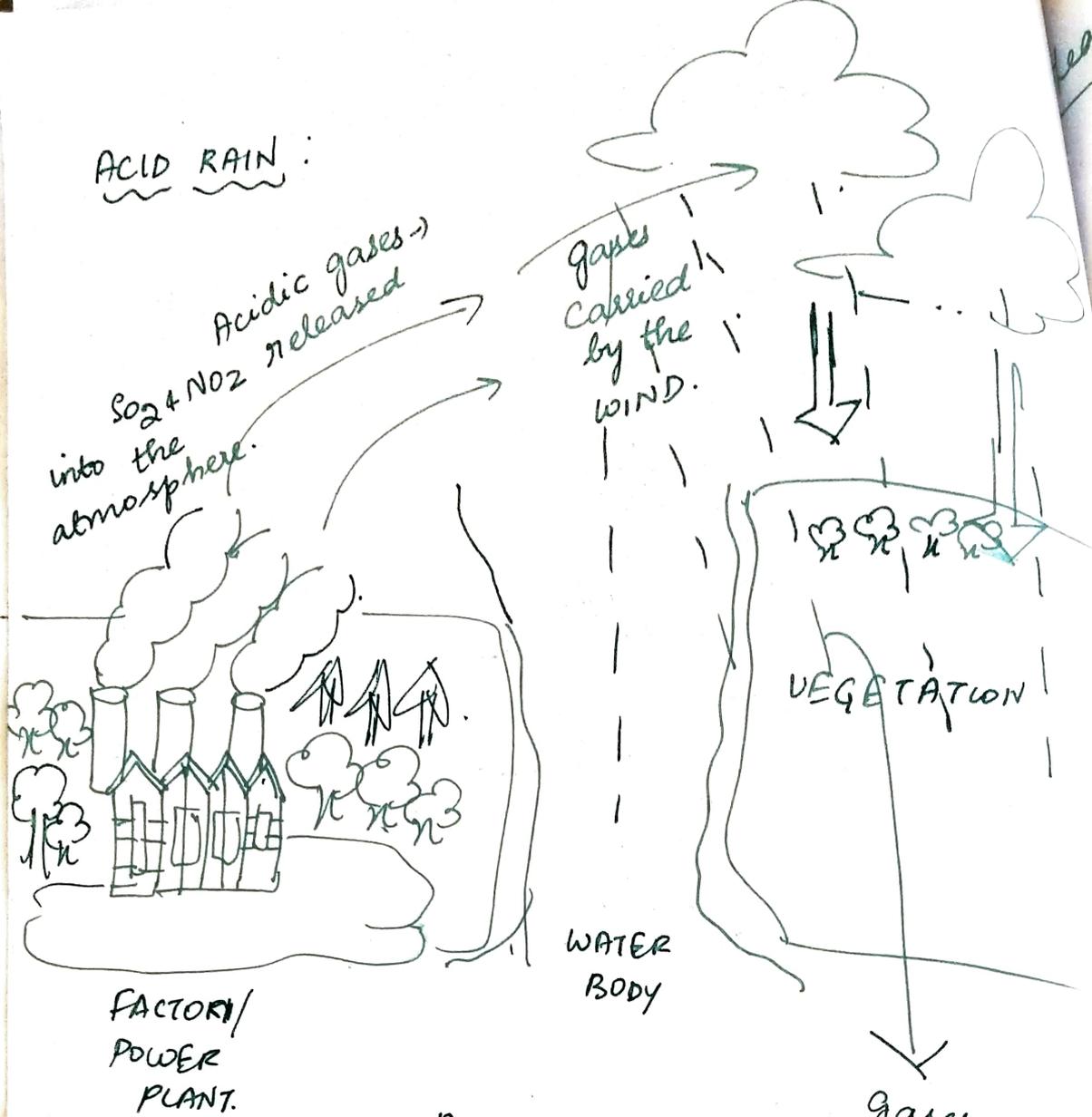
- To make more land available for housing & urbanization
- To harvest timber to create commercial items such as paper & furniture.
- For (space) cattle ranching.

* more green house gases, → CLIMATE CHANGE

Pyramid effects from Air Pollution:



ACID RAIN :



FACTORY/
POWER
PLANT.

WATER
BODY

VEGETATION

Gases
dissolve in
 H_2O to
form
Acid
rain.

ACID RAIN

kills plant life,
pollutes water bodies &
erodes stone
work.

eg: marble color change
of Tajmahal.

↳ Persian meaning: Crown of
Palaces.

1632, Shah
Opened in 1648. 1643, Jahan.

↳ 1653 (Comp)

@ 32 million
Indian rupees.

- 20,000 artisans.

Lead & heavy metals:

methane (CH₄):

Air Pollution: A physical, biological / chemical alteration to the air in the atmosphere.

It occurs when harmful gases, dust, smoke enters into the atmosphere.

Causes of air Pollution:

Burning of fossil fuels 2) Agricultural activities:

(SO₂) → Combustion of ff like coal, petroleum;

NH₃ → AMMONIA due to use of insecticides, pesticides, fertilizers.

mining operations:

4) Indoor air pollution:
(House hold cleaning pds).
(Paints).

Effects of Air Pollution:

1) Respiratory & heart problems:

Global warming.

5) Effect on wildlife.

Acid rain.

6) Depletion of ozone layer.

2) Eutrophication → condition where ↑ amt. of N₂ in pollutants gets developed on sea's surface & turns itself into algae & affects fish, plant & animal species.

Solutions of air Pollution:

- 1) Conserve energy: Kw: Fans, light; Electricity; Fossil fuels.
- 2) Reduce, reuse & Recycle.
- 3) Emphasis on Clean energy resources: (Solar, wind, geothermal)

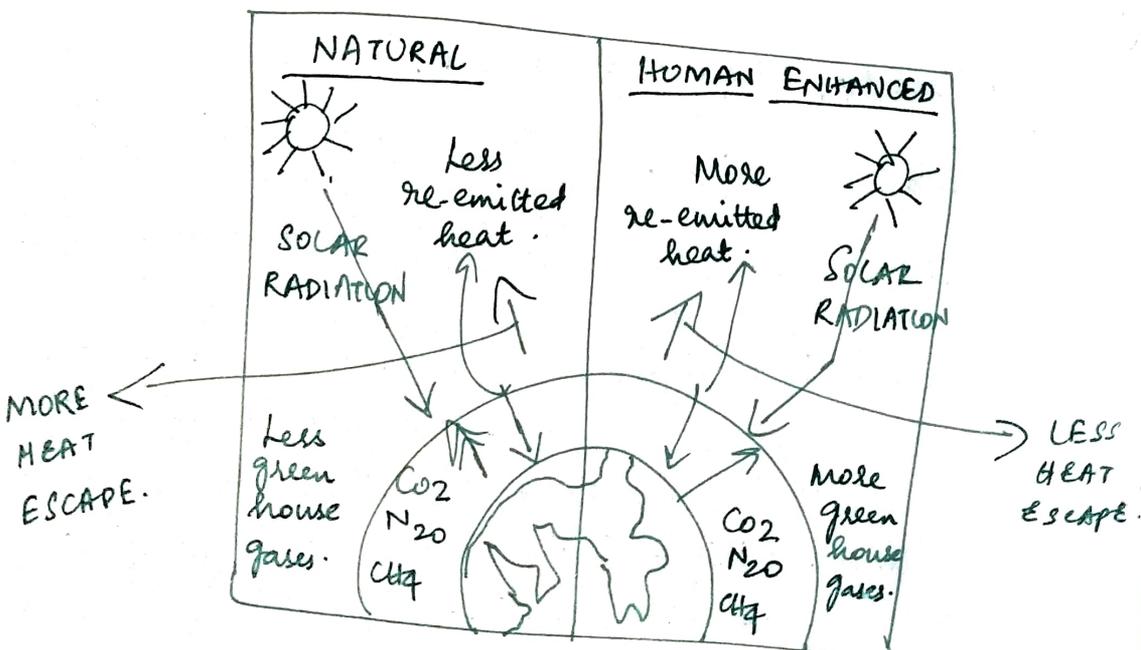
4)

AIR POLLUTANTS:

ATMOSPHERE: The envelope of gases surrounding the earth.

AIR: The invisible gaseous substance surrounding the earth, a mixture mainly of O_2 & N_2 .

GREEN HOUSE EFFECT:



AIR POLLUTION : \rightarrow Anthropogenic (by human activity).
 \rightarrow Natural source

Air is almost entirely made up of 2 gases.

78% N & 21% Oxygen + CO₂ + Argon (↓ qts).

(# any gas qualified as POLLUTANT if its level is HIGH).
Gases involved in air Pollution :

1) Sulfur dioxide : $S + O_2 (air) \rightarrow SO_2 (Prod)$.

\rightarrow (Major contributors: Coal - Power plants)

Harm: Acid rain, Smog, lung diseases.

2) CO : Very dangerous ^{forms} when fuels have too little O₂ to burn completely.

3) CO₂ : global warming & climate change.

4) NO₂ (Nitrogen dioxide) : & NO : (Indirect COMBUSTION)
 $N + O \rightarrow NO$

MC : \rightarrow Engines of vehicles
 \rightarrow Power plants.

Harm : \rightarrow Acid rain
 \rightarrow Ozone &
 \rightarrow Smog.
 \rightarrow Global warming.

5) Volatile organic Compounds (VOCs) :

\rightarrow Carbon-based org. chemicals that evaporate @ ordinary T & P \rightarrow so they readily become gases.
 \rightarrow chronic health effects.

GREENHOUSE GASES

- 6) Particulates: sooty deposits in air pollution that blacken buildings & cause breathing effects. (mostly from traffic fumes).
- 7) Ozone: TRI OXGEN (3 oxygen molecules & atoms) $[O_3]$.

Stratosphere (upper atmosphere)

OZONE

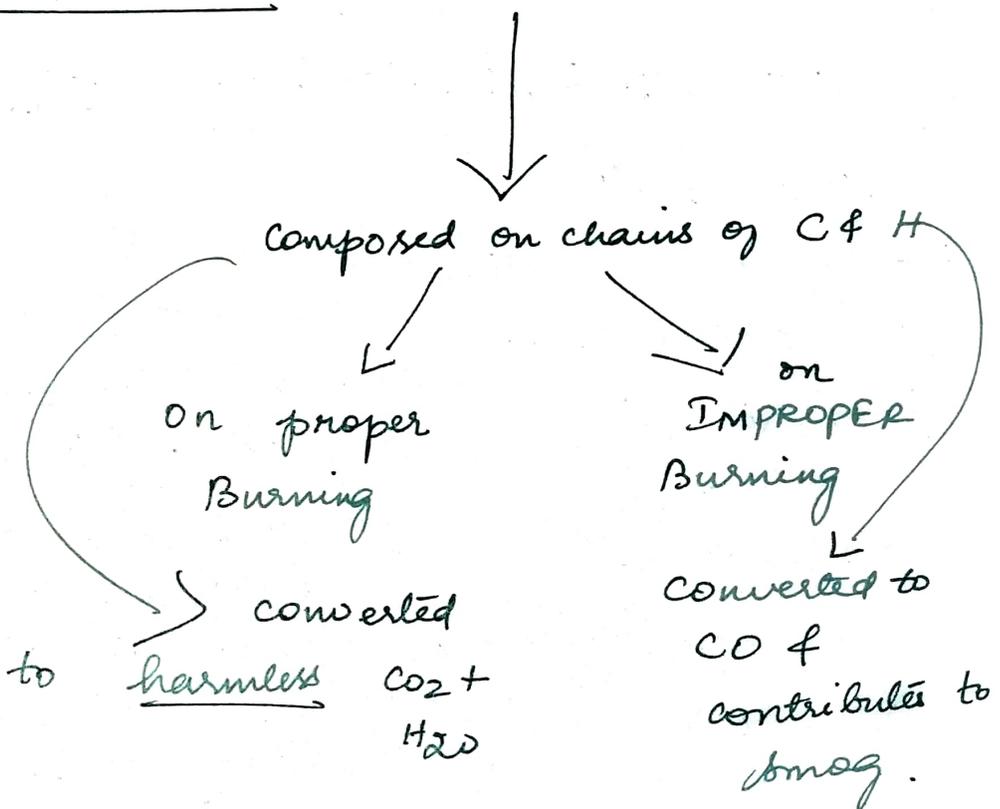
↓
Protects the earth by screening the UV light from the sun.

But @ ground level, → it's a toxic pollutant.

[Ozone + Particulates @ ground level].

8) CFC's: Refrigerators & aerosol cans.

9) Unburned HC's: Petroleum + other fuels.



SEDIMENTATION: It is the gravitational settlement of suspended and colloidal particles denser than water.

When sedimentation is done without the addition of any chemical coagulants, it is called PLAIN SEDIMENTATION.

When sedimentation process is adopted before any biological treatment process, it is called PRIMARY SEDIMENTATION.

Sedimentation tanks are made either in circular or rectangular shape and the major design parameters for the design of sedimentation tanks includes,

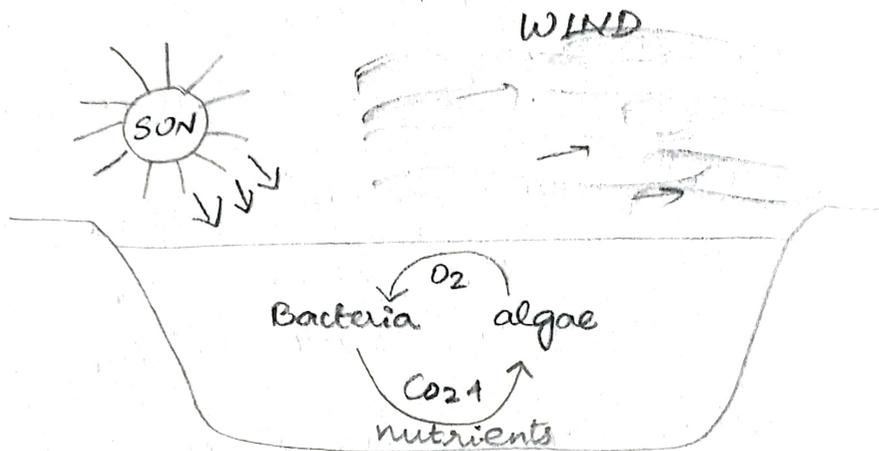
* Surface flow rate (or) Surface area loading:

This is the ratio of the discharge passing through the sedimentation tank to the plan area of the tank.

* Detention Time: It is the duration for which sewage is retained in the sedimentation tank & it is the ratio of the volume of the tank to the discharge passing through the tank.

* Horizontal flow velocity: To maintain laminar flow conditions in the sedimentation tank, it is necessary to maintain a horizontal flow velocity less than 0.3 m/s in the tank.

Oxidation Pond :



It is a low cost natural treatment system in which the oxygen required by the bacteria for the biochemical oxidation of organic matter is provided by the atmospheric winds & algae present in the oxidation pond. Algae utilize the nutrients and CO₂ provided by the bacteria for photosynthesis and supplements the bacteria with oxygen, a product of photosynthesis. "This SYMBIOTIC RELATIONSHIP BETWEEN THE ALGAE AND BACTERIA IS A MAJOR FEATURE OF THE OXIDATION POND".

Since the aeration process in oxidation ponds are essentially based on natural process, the depth of the pond must be MINIMAL (0.5m) to make the pond AEROBIC.

If the depth of the pond is more than, enough oxygen will not be reaching the bottom portions and the anaerobic digestion will start. To avoid this, mechanical aerators can be employed and the treatment system is known as AERATED LAGOON.

Constructed wetlands:

These are engineered marshes that duplicate natural processes to cleanse water.

Two types of constructed wetlands exist. They are,

a) FREE WATER SURFACE CONSTRUCTED WETLAND.

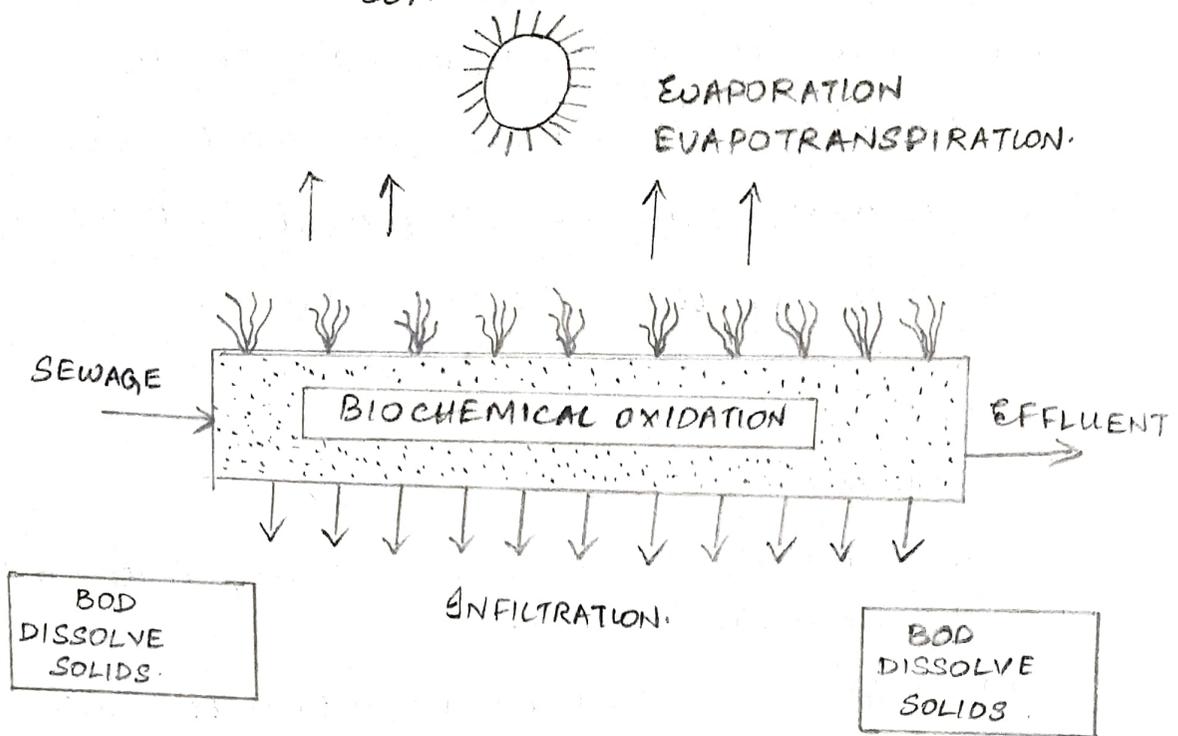
- Soil supports the roots of the emergent vegetation and water at a relatively shallow depth, generally less than 0.5 m, flows through the system with the water surface exposed to the atmosphere.

b) SUBSURFACE FLOW CONSTRUCTED WETLAND.

- It consists of suitable depth (0.4-0.8 m) of permeable media through which the water flows. The media also supports the root structure of the emergent vegetation.

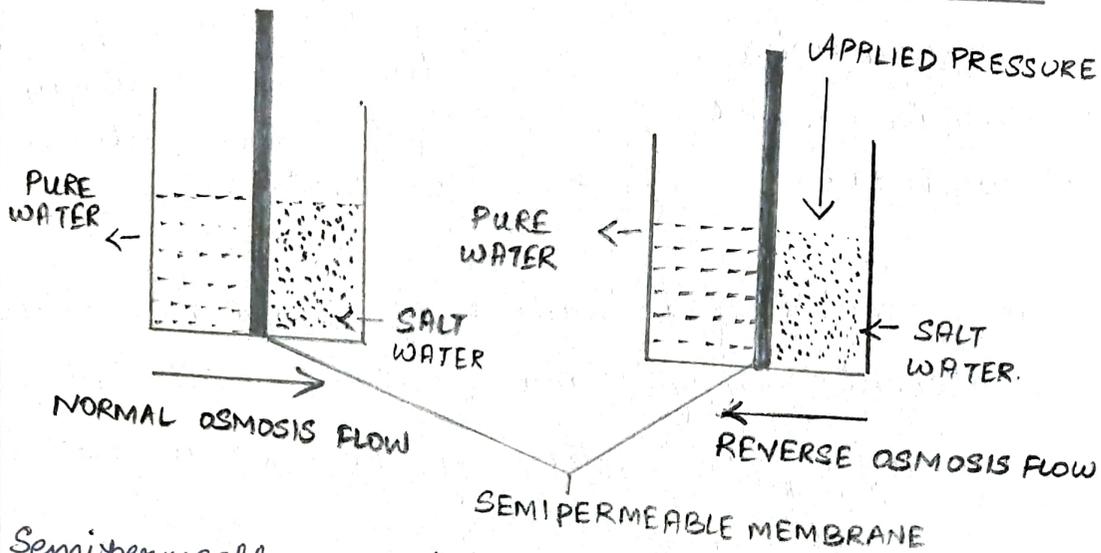
Both types consist of a channel or a basin with barriers to prevent seepage and utilize emergent aquatic vegetation as part of the treatment system.

CONSTRUCTED WETLAND.



Reverse osmosis: This phenomenon was introduced in 1950. This process employs a semipermeable membrane that separates an extremely high percentage of all unwanted material at the molecular level.

PRINCIPLE OF OSMOSIS & REVERSE OSMOSIS:



Semipermeable materials: These materials are used for efficient desalination.

CELLULOSE ACETATE

CELLULOSE TRI-
ACETATE

THIN FILM COMPOSITE.

- Chlorine tolerant.
- Non-bacteria resistant.
- Ideal operating PH between 6 to 8.

- Ideal operating PH range between 4 to 8
- Excellent water production rate.
- Resistant to most bacteria.

- PH range between 3 to 11
- Highest salt rejection capacity.
- Longest membrane life.
- Chlorine sensitive, it should be removed up-stream of the membrane.