Vikash Polytechnic, Bargarh
Vikash Polytechnic
Campus: Vikash Knowledge Hub, Barahaguda Canal Chowk,NH6
PO/DIST: Bargarh-768028, Odisha

Lecture Note on – Environmental Studies

Diploma 1st Semester

Branch - All

Submitted By:- Swagatika MIshra
Assistant Professor

UNIT - 1
ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY

1.1 ENVIRONMENT

Environmental science is the study of nature and the facts about environment. Environment can be defined as "all the social, economical, physical and chemical factors that surrounds man" or "all abiotic and biotic components around man-all living and non living things surrounds man".

1.1.1 PREREQUISITE DISCUSSIONS

The word environment is derived from the French word 'environ' which means to 'encircle or surround'.

Objective of this course is to develop concern for our own environment which will lead us to act at our own level to protect the environment we all live in.

Ever since people first recognized that their health and well-being were related to the quality of their environment, they have applied thoughtful principles to attempt to improve the quality of their environment.

There are three reasons for studying the state of the environment.

The first is the need for information that clarifies modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.

Second, there is a need to change the way in which we view our own environment, using practical approach based on observation and self learning.

Third, there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.

1.1.2 CONCEPTS

According to ancient man the environment was the Panchaboodhas (i.e.) air, water, land, sky and energy.

The human were disciples of nature. They were able to protect themselves from harmful one and protect the others. But according to modern man the environment is only air land and water.

Exploitation of various earth resources to satisfy the increasing needs of human population has resulted in 1) depletion of various resources of earth 2) pollution. Principles of environmental education

- Examine the major environmental issues
- Discover the root cause
- Develop problem solving skills
- Promote co-operation in solving problems
- Emphasis active participation in prevention and solution to problems

1.1.3 SCOPE OF ENVIRONMENTAL SCIENCE

- Studying the interrelationship between the components of environment.
- Carrying out impact analysis and Environmental Audit
- Preventing pollution from existing and new industries
- Stopping the use of biological and nuclear weapons
- Managing unpredictable disasters etc.

1.1.4 PUBLIC AWARENESS

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.

- Public awareness of environmental issue is at infant stage
- 30-40% of public of developing country are aware of environmental. Problems but they do not bother about it.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in std. of living has lead to serious environmental disasters.
- Debates on environmental Issues are treated as anti-developmental.

1.1.5 APPLICATION

- Environmental science is essentially the application of scientific methods and principles to the study of environmental issues, so it has probably been around in some forms as long as science itself.
- Environmental science is often confused with other fields of related interest, especially ecology, environmental studies, environmental education and environmental engineering.
- Environmental science is not constrained with any one discipline and it is a comprehensive field.

1.1.6 RISK AND HAZARDS IN THE ENVIRONMENT

Environmental risk due to various environmental hazards is an important topic for environmental engineers to recognise and understand in order to protect human society and ecosystems from harms or damages at local, regional or global scales. For example, to deal with contaminated soil and ground water at a brown field, risk and exposure assessment help engineers choose an optimal solution to either treat the hazard (e.g., to remove the contaminants from the soil and water) or reduce the exposure (e.g., to cover up the land with a barrier).

A hazard is a threat to life, health, property, or ecosystems, i.e., it involves something that could potentially be harmful. Therefore, when a dormant hazard comes to fruition, it will cause physical damage or destruction, loss of life, or drastic change to the environment, and result in an incident, accident, emergency event, or disaster. Hazards may be classified into

- Chemical hazards – Combustion of Fossil fuels, industrial effluence, pesticides heavy metals.
- Physical hazards – Radioactive and UV radiations, Global warming, Chlorofluro carbons, Noise etc.
- Biological hazards – Bacteria, Viruses, Parasites.

1.2 ECOSYSTEM

Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the farmer.

An ecosystem is therefore defined as a natural functional ecological unit comprising of living organisms and their non-living environment that interact to form a stable self supporting system.

1.2.1 PREREQUISITE DISCUSSIONS

EO Wilson is an entomologist who envisioned that biological diversity was a key to human survival on Earth. He wrote 'Diversity of life' in 1993, which was awarded a prize for the best book published on environmental issues.

He emphasised the risks to mankind due to manmade disturbances in natural ecosystems that are leading to the rapid extinction of species at the global level.

An Indian ornithologist and naturalist, Salim Ali known as the "birdman of India", was among the first Indians to conduct systematic bird surveys across India.

He was instrumental in creating the Bharatpur bird sanctuary (Keoladeo National Park) and prevented the destruction of what is now the Silent Valley National Park. He was awarded India's second highest civilian honour, the Padma Vibhushan in 1976.

His autobiography, **Fall of a sparrow**, should be read by every nature enthusiast. He was our country's leading conservation scientist and influenced environmental policies in our country for over 50 years.

1.2.2 CONCEPTS

Ecology is the study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

Structure of Ecosystem

1. Abiotic or non-living components or physical components
2. Biotic or Living components
3. Energy components

Function of organisms in an ecosystem

- Producer (autotrophy): make food; plants, algae
- Consumer (heterotrophy): eat other organisms
- Decomposer; eat dead organic matter; bacteria and fungi

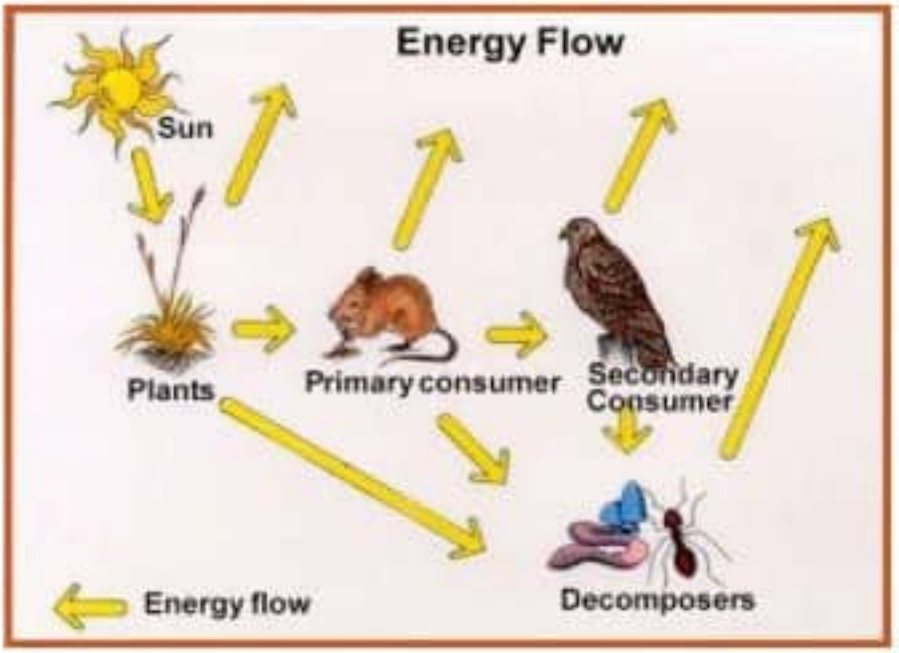
Classes of Consumers

- Herbivore – primary consumer – eats plants
- Carnivores – secondary – meat eaters; eat herbivores
- Tertiary – feed on carnivores
- Omnivores – eat plants/animals

1.2.3 ENERGY FLOW IN ECOSYSTEM

- All organisms must obtain a supply of energy and nutrients from their environment in order to survive.
- The transformations of energy in an ecosystem begin first with the input of energy from the sun.
- Because, it is the first step in the production of energy for living things, it is called "Primary production".
- Photosynthesis -- Chemical reaction where green plants use water & carbon dioxide to store the sun's energy in glucose.
- ENERGY is stored in glucose.
- Glucose is stored as starch in plants
- The majority of autotrophs are photoautotrophs that harness the energy of the sun and pass some of this energy onto consumers through feeding pathways.
- The energy contained within producers and consumers is ultimately passed to the decomposers that are responsible for the constant recycling of nutrients.

- Thus, there is a one-way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem.
- Energy flow cannot occur in reverse direction.



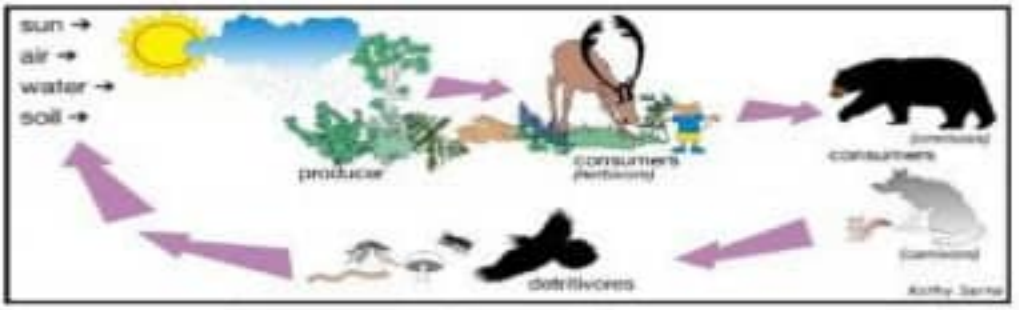
Energy Flow

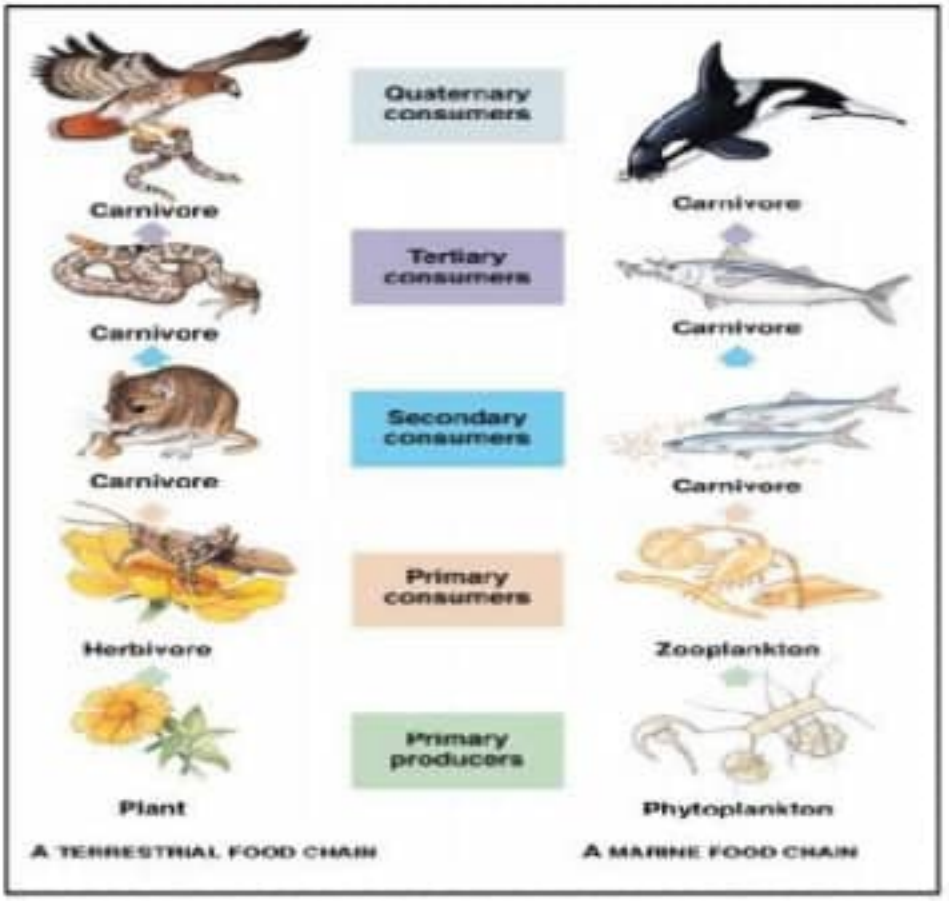
- Starts from autotrophs (the producer level, i.e., first trophic level) to Heterotrophs including plant eaters or Herbivores (second trophic level) and so on.
- The amount of energy decreases with successive trophic levels.
- Only About 1% of energy from the sun is used by green plants & rest remains unutilized.
- Similarly, there is loss of energy in each trophic level.
- The transfer of food energy between the organisms in an ecosystem can be tracked by constructing food chains, food webs, pyramids of numbers, biomass and energy and energy flow diagrams.

1.2.4 FOOD CHAIN

Plants by photosynthesis convert solar energy into protoplasm. Small herbivores consume the vegetable matter and convert into animal matter which in turn eaten by large carnivores.

- 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.

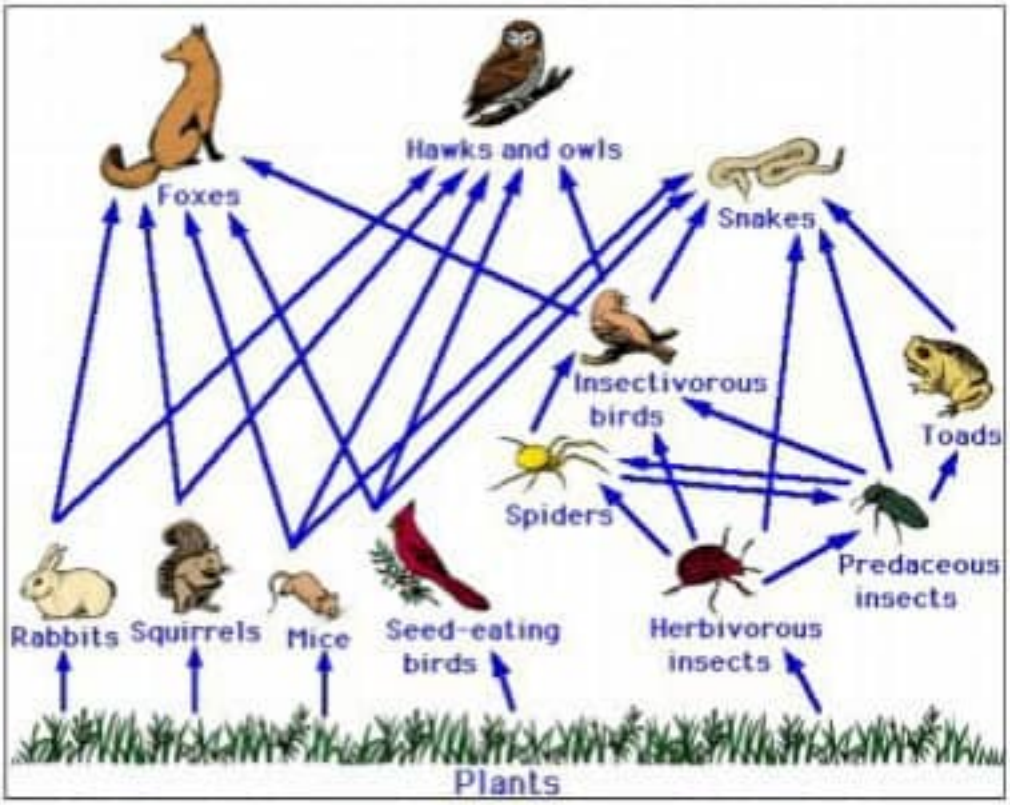




Food Chain

1.2.5 FOOD WEB

The food relationship between various organisms is being depicted by linking all the possible prey and predators of different food level. In an ecosystem linking of feeding habit relations will provide a food web or Interlocking pattern of several interlinked food chains is termed as FOOD WEB.



Food web in grassland ecosystem

1.2.6 ECOLOGICAL PYRAMIDS

An"Ecological pyramid" is a graphical representation that shows the relative amounts of energy or matter contained within each tropic level in a food chain or food web.

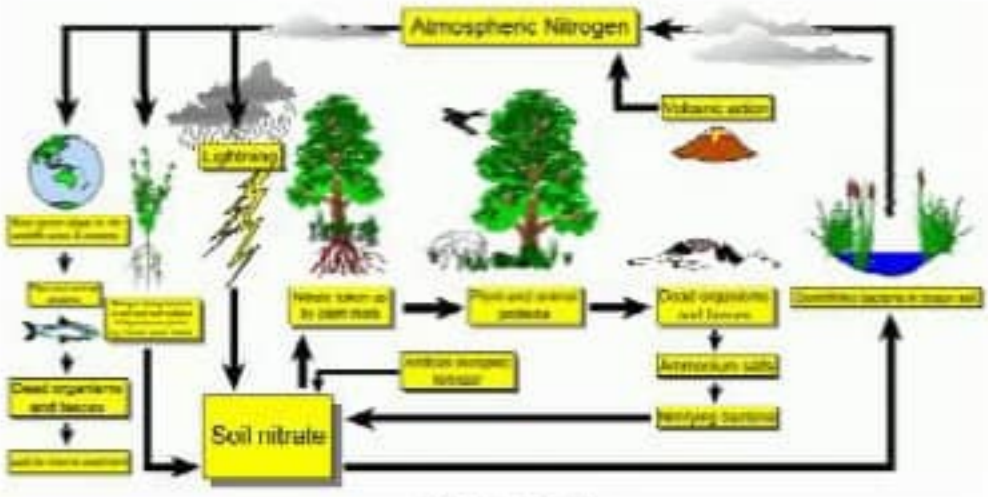
An ecological pyramid shows the relationship between consumers and producers at different tropic levels in an ecosystem.

Ecological Pyramid

Pyramid of Energy

1.2.7 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

Nitogen cycle completes in 5 steps:

1) Nitrogen Fixation

Conversion of $N_2 \rightarrow NH_3$

Combustion, volcanic action, Lightning, Industrial processes (making fertilizer).

Bacteria (Azotobacter, Clostridium, Nostoc etc.)

2) Nitrification

Conversion of $NH_3 \rightarrow NO_3$

Soil bacteria convert in a two step process.

3) Assimilation

Roots absorb NH_3, NH_4, or NO_3 and incorporate them into nucleic acids and protein.

4) Ammonification

Amino acids and nucleotides are broken down into waste products NH_3 or NH_4

5) Denitrification

The reduction of NO_3 to N_2. Denitrifying bacteria return some of the nitrogen to the atmosphere

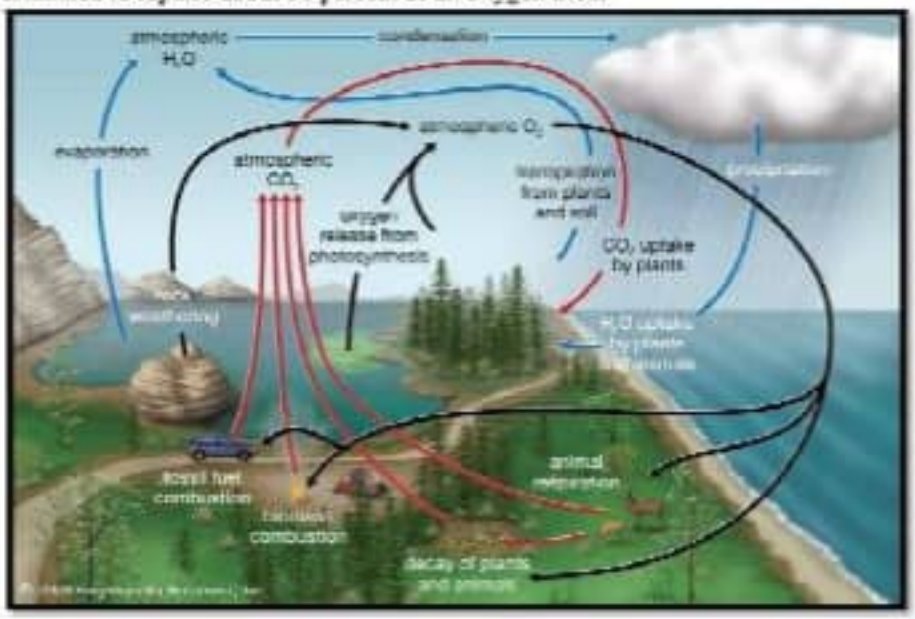
1.2.8 OXYGEN CYCLE

oxygen cycle is the circulation of oxygen in various forms through nature free in the air and dissolved in water.

Oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere.

Plants and animals use oxygen to respire and return it to the air and water as carbon dioxide (CO_2). CO_2 is then taken up by algae and terrestrial green plants and converted into carbohydrates during the process of photosynthesis, oxygen being a by-product.

The waters of the world are the main oxygen generators of the biosphere; their algae are estimated to replace about 90 percent of all oxygen used.



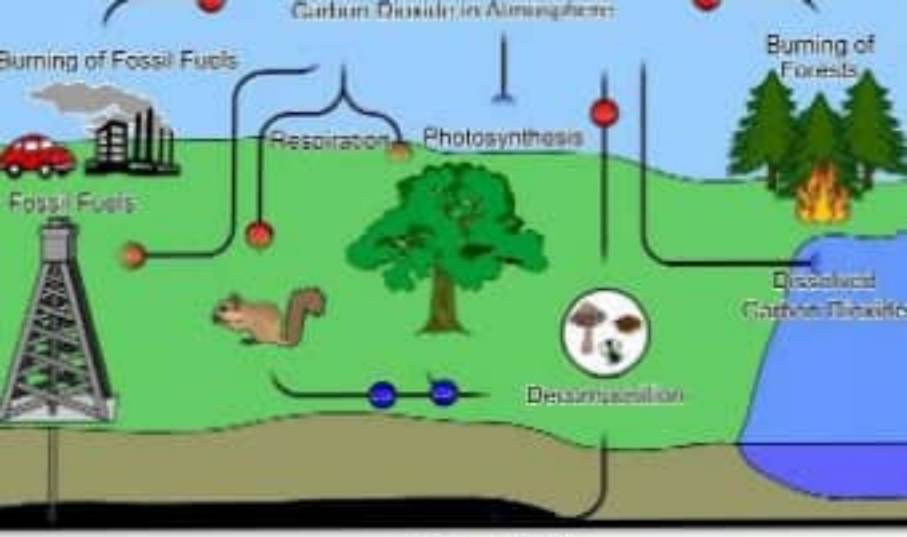
The generalized oxygen cycle

Oxygen is involved to some degree in all the other biogeochemical cycles. For example, over time, detritus from living organisms transfers oxygen-containing compounds such as calcium carbonates into the lithosphere.

Despite the burning of fossil fuel and the reduction of natural vegetation (on land and in the sea), the level of atmospheric oxygen appears to be relatively stable because of the increase in plant productivity resulting from agricultural advances worldwide.

1.2.9 CARBON CYCLE

- Carbon enters plants, etc., as CO2
  - Bacteria process carbon in a fashion that allows it to be recycled.
  - Obtain energy from the molecules, and convert carbohydrates to carbon dioxide as a result of respiration.
- Photosynthesis removes carbon from the abiotic environment (fixes carbon into organic molecules)
- Carbon moves through food chain through consumption of one organisms by another

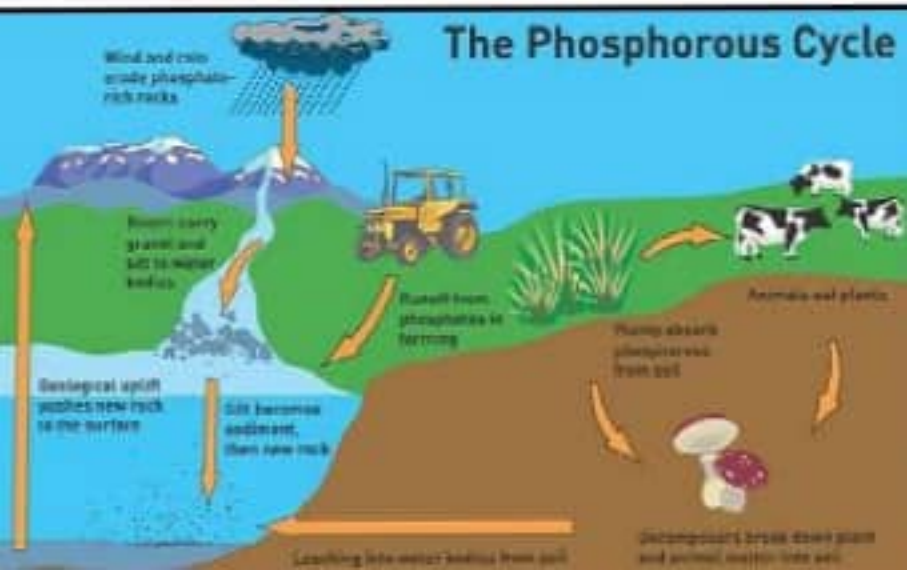


Carbon Cycle

source of atmospheric carbon dioxide is variable but only plants can utilize atmosph
on directly.

0 PHOSPHOROUS CYCLE

The only cycle that does not have a gaseous state.
Inorganic phosphate PO_4^{3-} is released from rocks and sediments through the actio
erosion.



Causes, effects and control of noise and thermal pollution.

Noise pollution

Noise is perhaps one of the most undesirable by products of modern mechanized lifestyle. It may not seem as insidious or harmful as the contamination of drinking water supplies from hazardous chemicals, but it is a problem that affects human health and well-being and that can also contribute to the general deterioration of environmental quality. It can affect people at home, in their community, or at their place of work.

Sound waves cause eardrums to vibrate, activating middle and inner organs and sending bioelectrical signals to the brain. The human ear can detect sounds in the frequency range of about 20 to 20,000 Hz, but for most people hearing is best in the range of 200 to 10,000 Hz. A sound of 50 Hz frequency, for example, is perceived to be very low-pitched, and a 15,000 - Hz sound is very high pitched.

Simply defined, noise is undesirable and unwanted sound. It takes energy to produce sound, so, in a manner of speaking, noise is a form of waste energy. It is not a substance that can accumulate in the environment, like most other pollutants, but it can be diluted with distance from a source. All sounds come from a sound source, whether it be a radio, a machine, a human voice, an airplane, or a musical instrument. Not all sound is noise. What may be considered music to one person may be nothing but noise to another. To a extent, noise pollution is a matter of opinion. Noise is measured in terms of Decibel units.

Sources of noise

Based on the type of noise include

a) Industrial Noise

b) Transport Noise

C) Neighbourhood Noise

Industrial Noise

It is caused by machines used for the technological advancement. There exist a long list of sources of noise pollution including different machines of numerous factories, industries and mills.

Transport Noise:

Main source is transport. In addition to adversely impacting urban air quality, heavy automobile traffic creates seemingly unbearable noise pollution. Ever since industrial revolution doubling of noise for every 10 years

Pointed nose that angles downward during takeoff, the Anglo-French Concorde flies at more than twice the speed of sound. Supersonic plane is very noisy, and some believe its sonic booms harm the environment.

Animals such as whales use water to communicate with one another over great distances. Human-generated noises in the ocean, such as engine noises by boats, may interfere with animal communication.

Measurement of noise

The noise is usually measured either by i) Sound Pressure or ii) Sound Intensity. The Sound intensity is measured in Decibel (dB), which is tenth part of the longest unit "Bel" named after Alexander Graham Bell. Decibel (dB) is a ratio expressed as the logarithmic scale relative to a reference sound pressure level. The db is thus expressed as

$$\text{Sound Intensity Level} = 10 \log \frac{\text{Intensity Measured (I)}}{\text{Reference intensity } (I_0)}$$

or $dB = 10 \log I / I_0$

Intensity of Noise sources

Sources	Intensity(dB)
Breathing	10
Trickling clock	20-30
Normal conversation	35-60
Office noise	60 - 80
Traffic	50-90
Motor cycle	105
Jet fly	100 - 110

Effects of Noise Pollution

Auditory effects

- Auditory fatigue -- Whistling & buzzing in ears(noise level - 90dB)
- Deafness -- Permanent hearing loss (noise level- 100dB)

Tinnitus

- Persistent sound in one or both ears.
- Tinnitus is often experienced as a high-pitched hiss, ring, buzz, or roar.
- It is usually continuous, but it may pulsate, and the beats may coincide with the heartbeat.

Non auditory effects

- Interference with speech communication - 50dB
- Annoyance, ill temper, bickering
- loss in working efficiency - tiredness, deterioration or complete loss of ability to work

Physiological disorders

Neurosis, anxiety, hypertension, increased sweating, giddiness, nausea, fatigue, visual disturbance, reduces depth and quality of sleep , peptic ulcers, Increases cholesterol level resulting in constriction of blood vessel , Low weight children to mothers

Noise intensity	Health hazards
80	Annoyance
90	Hearing damage
95	Very annoying
110	Stimulation of reception in skin
120	Pain threshold
130	Nausea,vomiting
140	Pain in ear
150	Burning of skin
160	Rupture of tymphonic membrane
180	Permanent damage

Even the nonliving things such as buildings undergo physical damage by cracks, breakage of windows, doors, and glasses etc. by sudden and explosive sounds.

Control of Noise Pollution

Noise definitely affects the quality of life. It is therefore important to ensure the mitigation or control of noise pollution. Noise pollution can be controlled

- At source level – Can be done by i) Designing and fabricating silencing devices in air craft engines, automobiles industrial machines and home appliances, ii) By segregating the noisy machines

- During Transmission – can be achieved by adding insulation and sound-proofing to doors, around industrial machinery. Zoning urban areas to maintain a separation between residential areas and zones of excessive noise. Sound
  a) Acoustillite : made up of Compressed wood pulp, wood fibers and is available in the form of tiles
  b) Acoustical blanket : Prepared from mineral wool or glass fibres
  c) Hair Felt: Consists of wool fibres, Coarse Cotton Fibres.
  d) Fibre Glass
  e) Cork Carpet: Prepared out of pieces of corks treated with linseed oil and is used for covering floors.
  f) Acoustic Plaster: Mainly consists of gypsum in the form of plaster.
- Protecting the exposed person
- By creating vegetation cover – Plants absorb and dissipate sound energy and thus act as Buffer Zone. Trees should be planted along highways, schools and other places.

Planting vegetation to absorb and screen out noise pollution – Trees can act as a noise barrier

- Through law
  a) Silence Zones must be created near Schools, hospitals
  b) Indiscriminate use of loudspeakers at public places should be banned/restricted by laws
  c) Restriction on unnecessary us e of horns and vehicles plying without silencers

d) Restrictions on aircraft flight at midnight

Permissible Ambient Noise Level in Different areas

Area	Code category	Noise level (dB)	
		Day Time (6 to 9 Am)	Night Time (9 to 6 PM)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

a) The Air (prevention and control of pollution) Act, 1981
b) The Motor Vehicles Act,1988
c) Indian Penal Code – Sections 268 & 290

- Through education - We Indians are Noisy people. Every occasion, it may be religious or family functions or elections; we used to celebrate with noise. Educating the people that noise is a pollutant, not a part of our routine life.

Thermal Pollution

The term thermal pollution has traditionally been used more often to refer to the heating of lakes, river, streams, and other water bodies usually by electric power generating plants or by factories

- The combustion of fossil fuels always produces heat, sometimes as a primary desired product, and sometimes as a secondary, less desired by-product i.e. noise
- Heat is also produced when fossil fuels are burned to generate electricity. In this case, heat is a by-product, not the main reason that fuels are burned.
- Electricity is also generated in nuclear power plants, when no combustion occurs.
- The decay of organic matter in landfills also releases heat to the atmosphere.

It is clear, therefore, that a vast array of human activities result in the release of heat to the environment. As those activities increase in number and extent, so does the amount of heat released. In many cases, heat added to the environment begins to cause problems for plants, humans, or other animals. This effect is then known as *thermal pollution.*

Sources of Thermal pollution

- Coal fired power plant effluents
- Domestic sewage
- Hydroelectric power effluent
- Industrial effluents
- Nuclear power plants

Effects of thermal Pollution

A one megawatt nuclear power plant may require 1.3 billion gallons (five million m^3) of cooling water each day. The water used in such a plant has its temperature increased by about 63°F (17°C) during the cooling process. For this reason, such plants are usually built very close to an abundant water supply such as a lake, a large river, or the ocean.

When thermal pollution drives water temperatures up, most aquatic and marine wildlife cannot survive. Immobile organisms, such as plants and shellfish, simply die. One inevitable result of thermal pollution is a reduction in the amount dissolved oxygen in water. The amount of any gas that can be dissolved in water varies inversely with the temperature. As water is warmed, therefore, it is capable of dissolving less and less oxygen. Organisms that need oxygen to survive will, in such cases, cant be able to survive.

When heated water is released from a plant or factory, it does not readily mix with the cooler water around it. Instead, it forms a stream-like mass known as a thermal plume that spreads out from the outflow pipes. It is in this thermal plume that the most severe effects of thermal pollution are likely to occur. Only over an extended period of time does the plume gradually mix with surrounding water, producing a mass of homogenous temperature

Invasion of Destructive Organism

Water temperatures can have other, less expected effects also. As an example, trout can swim less rapidly in water above 66°F (19°C) making them less efficient predators. Organisms may become more subject to disease in warmer water too. The bacterium *Chondrococcus columnaris* is harmless to fish at temperatures of less than 50°F (10°C). Between temperatures of 50° - 70°F (10° - 21°C), however, it is able to invade through wounds in a fish's body and at temperatures above 70°F (21°C) it can even attack healthy tissue.

Urban Heat dome

Another example of thermal pollution is the development of urban heat islands. An urban heat island consists of a dome of warm air over an urban area caused by the release of heat in the region. Since more human activity occurs in an urban area than in the surrounding rural areas, the atmosphere over the urban area becomes warmer than it is over the rural areas.

It is not uncommon for urban heat islands to produce measurable climate changes. For example, the levels of pollutants trapped in an urban heat island can reach 5 to 25 percent greater than the levels over rural areas. Fog and clouds may reach twice the level of comparable rural areas, wind speeds may be produced by up to 30 per cent, and temperatures may be 32.9° - 35.6°F (0.5° - 2°C) higher than in surrounding rural areas. Such differences may cause both personal discomfort and, in some cases, actual health problems for those living within an urban heat island.

Thermal Air Pollution

Undesirable changes in Algal population: Excess Nutrients from the washout water from farm lands combined with thermal pollution cause an excessive algal growth with consequent changes. High Temperature promotes blue green algal blooms which disrupts the aquatic food chain.

Control of Thermal pollution

The water heated by thermal pollution also has a number of potential useful applications. For example, it may be possible to establish aquatic farms where commercially desirable fish and shellfish can be raised. The Japanese have been especially successful in pursuing this option. Some experts have also suggested using this water to heat buildings, to remove snow, to fill swimming pools, to use for irrigation, to de-ice canals, and to operate industrial processes that have modest heat requirements. Hot water is pumped into one end of the pond and cooler water is removed from the other end. The heat gets dissipated from the pond into the atmosphere. The main disadvantage is large amounts of water are lost due to evaporation

Here at Westport, Kentucky the Ohio River provides the large amount of water required by this coal-fired power plant. Thermal pollution is abated by the use of the large cooling tower which emits only steam into the atmosphere. The emission of the smokestack is largely steam but still contains pollutants.

WATER POLLUTION

- Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans and ground waters).
- Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.
- Water pollution affects plants and organisms living in these bodies of water.
- In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.

Water pollution

- Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international level down to individual aquifers and wells).
- It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily.
- An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrheal sickness every day.
- Some 90 % of China's cities suffer from some degree of water pollution, and nearly 500 million people lack access to safe drinking water.
- In addition to the acute problems of water pollution in developing countries, industrialized countries, continue to struggle with pollution problems as well.
- In the most recent national report on water quality in the USA, 45 % of assessed stream km, 47 % of assessed lake ha, and 32 % of assessed bay and estuarine square km were classified as polluted.
- Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water.
- Natural phenomena such as volcanoes, algae blooms, storms and earthquakes also cause major changes in water quality and the ecological status of water.

The Water Framework Directive

(Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy)

This EU directive commits EU member states to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015.

The directive defines "surface water status" as the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status.

Thus, to achieve "good surface water status" both the ecological status and the chemical status of a surface water body need to be at least "good".

Ecological status refers to the quality of the structure and functioning of aquatic ecosystems of the surface waters. Water is an important facet of all life and the water framework directive sets standards which ensure the safe access of this resource.

The Directive requires the production of a number of key documents over six year planning cycles. Most important among these is the River Basin Management Plans, to be published in 2009, 2015 and 2021. Draft River Basin Management Plans are published for consultation at least one year prior.

Good ecological status is defined locally as being lower than a theoretical reference point of pristine conditions, i.e. in the absence of anthropogenic influence.

Article 14 of the directive requires member states "to encourage the active involvement of interested parties" in the implementation of the directive.

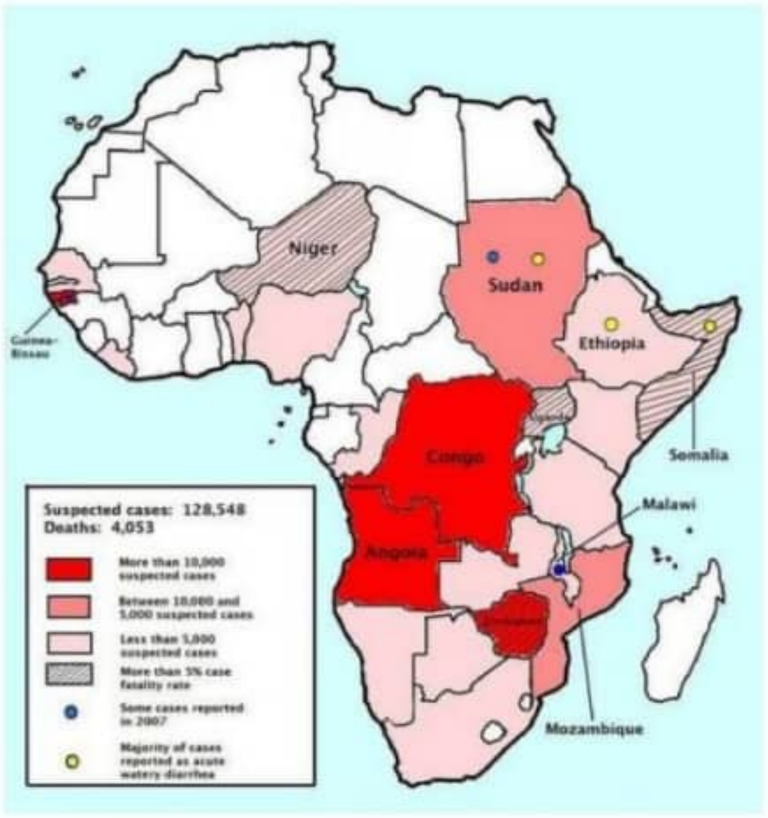
WATER POLLUTION AND MORBIDITY

Link between water pollution and morbidity (saslimstība) has been equipollent stated due to cholera epidemic in London, 1854.

Transmission is primarily due to the faeces contamination of food and water due to poor sanitation. This bacterium can, however, live naturally in any environment.

CHOLERA EPIDEMICS IN AFRICA

2008–2009



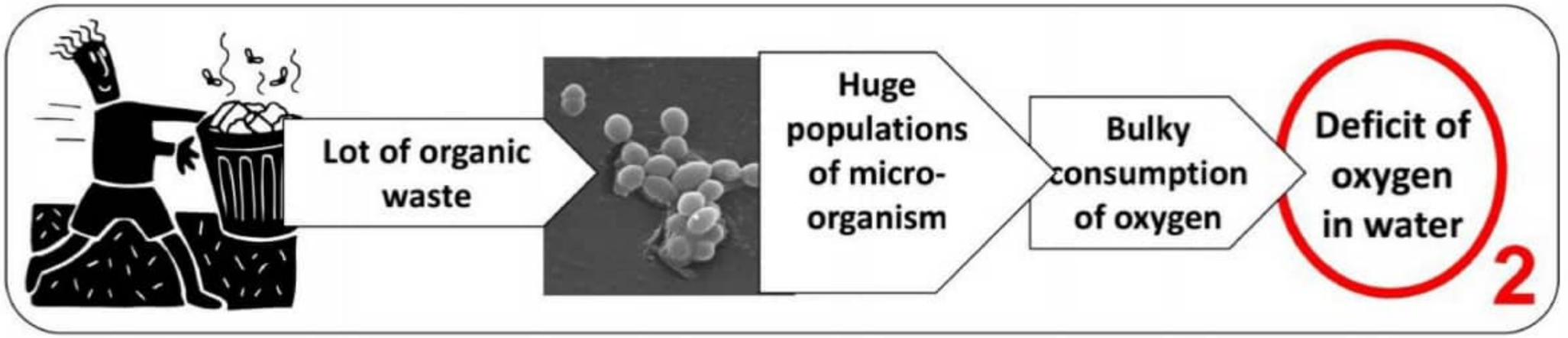
Map of the 2008–2009 cholera outbreak in sub-Saharan Africa showing the statistics as of 12 February 2009.

2014–2015

Declared in June 2014, the **West and Central African cholera outbreak** as of January 25, 2015 claimed 1,683 registered deaths and over 91,361 reported cases with a reported case fatality rate of 2 % in 11 countries, which is 3 times more than in 2013. The case fatality ratio is high in the Sahelian area, equal or greater than 2 %, especially in Nigeria, Chad, Cameroon, and Niger, Nigeria, Ghana and Democratic Republik of the Congo being the most affected countries with Ghana reporting its worst outbreak since 1982. In January 2015 the Greater Accra region and Volta region still reported cases of Cholera while in the rest of Ghana the outbreak was declared over. As of January 11 the Democratic Republic of the Congo, Ghana and Nigeria are the countries with highest number of new cases of the disease in 2015.

WATER POLLUTANT GROUPS

1. **Oxygen-depleting substances : organic waste, used by aerobic microorganisms in presence of oxygen.**



If concentration of oxygen in water is insufficient, oxygen consumed living creations can go out.

Very important is to know what is the biochemical oxygen demand (BOD).

The BOD_5 value is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a robust surrogate of the degree of organic pollution of water.

WATER POLLUTANT GROUPS

2. **Water soluble inorganic substances**: salts, acids, compounds of heavy metals. Acidity caused by industrial discharges (especially sulphur dioxide from power plants). Presence in soil (via polluted water) of these substances reduce agricultural harvest, as well as to arouse corrosion of the metals.

3. **Inorganic nutrients for plants**: water soluble nitrates, phosphates, which are promoters of eutrophication. Ammonia from food processing waste.

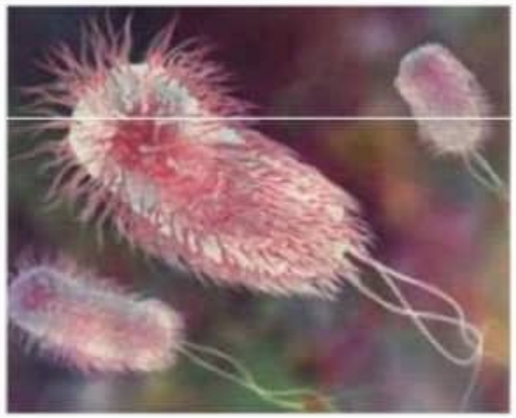
4. **Organic substances** : oil products, petrol, plastic, pesticides, solvents, detergents, *etc.*

In surface and ground waters of developed countries are find at least **700 synthetic organic substances** – many of them might to bring on an kidney illness, hereditary defects, a number of cancer varieties.

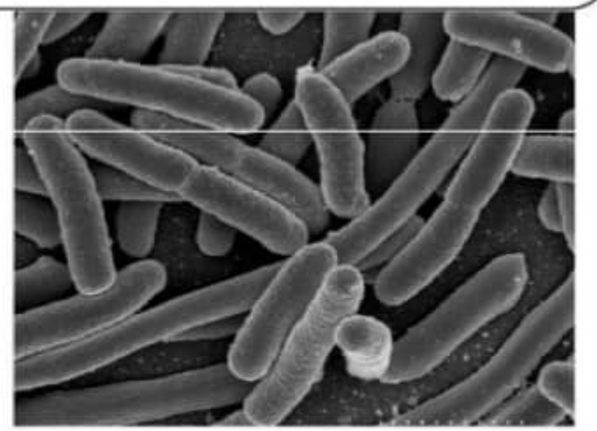
MICROORGANISMS IN WATER

Microorganisms and parasitic warms to get in water mainly from household wastewater.

Under constant wet and temperature conditions microorganisms fast multiply – accordingly household wastewater is ideal environment for microbes, primary bacteria, some viruses and protozoa existence.



Escherichia coli bacteria under different magnification



Analyses for detection of the pathogenic microorganisms are very complicated, therefore are used method don't search for individual pathogen species, but to carry out integral analyses, for example, to fix coli titre.

World Health Organisation recommend that in 100 ml drinking water don't be any *Escherichia coli* bacteria.

WASTEWATER

Wastewater is human changed waters with other physical, chemical and biological properties as natural waters.

Classification of wastewaters by origin:

- household wastewater
- municipal wastewater
- precipitation (rain) wastewater
- Industrial (production) wastewater

Deer Island Wastewater Treatment Plant serving
Boston, Massachusetts.

DOMESTIC SEWAGE

Quantity of wastewater per capita in day:
in small towns are **250 – 300 l,**
in big industrial cities up to **900 l.**

Domestic sewage is 99.9 percent pure water, while the other 0.1 percent are pollutants. Although found in low concentrations, these pollutants pose risk on a large scale.

In urban areas, domestic sewage is typically treated by centralized sewage treatment plants.

In the EU and US, most of these plants are operated by local government agencies, frequently referred to as publicly owned treatment works.

Municipal treatment plants are designed to control conventional pollutants : BOD and suspended solids.

Well-designed and operated systems (i.e., secondary treatment or better) can remove 90 percent or more of these pollutants. Some plants have additional sub-systems to treat nutrients and pathogens.

Most municipal plants are not designed to treat toxic pollutants found in industrial wastewater.

Households wastewater charasteristics:
temperature is 8-12°C,
transparency 4-10 cm, grey colour,
medium bog odour, neutral pH reaction

Content of households wastewater:
60-80% organic substances (meat and plants fibres, oils, human excrements and urine),
inorganic impurities (sand, mineral salts, acids, detergents),
living organisms: microorganisms, protea, warms,
alkali

INDUSTRIAL WASTEWATER

Some industrial facilities generate ordinary domestic sewage that can be treated by municipal facilities. Industries that generate wastewater with high concentrations of conventional pollutants (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or other nonconventional pollutants such as ammonia, **need specialized treatment systems**.

Some of these facilities can install a **pre-treatment system** to remove the toxic components, and then send the partially-treated wastewater to the municipal system. Industries generating large volumes of wastewater typically operate their own complete on-site treatment systems.

Some industries have been successful at redesigning their manufacturing processes to **reduce or eliminate pollutants**, through a process called pollution prevention.

Heated water generated by power plants or manufacturing plants may be controlled with:

- cooling ponds, man-made bodies of water designed for cooling by evaporation, convection and radiation,
- cooling towers, which transfer waste heat to the atmosphere through evaporation and heat transfer,
- cogeneration, a process where waste heat is recycled for domestic and/or industrial heating purposes.

INDUSTRIAL WASTEWATER QUANTITY

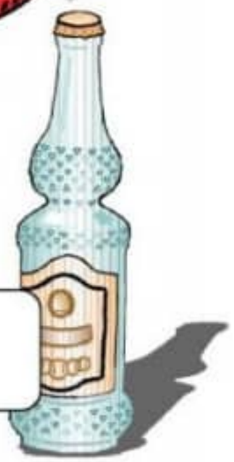
Wastewater amount by processing of the one unit (kg or l) of the product:

Milk: 0,5-4 l

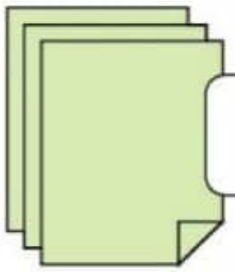
Canned fish : 17-45 l

Meat: 1-3 l

Beer: 2,5-15 l



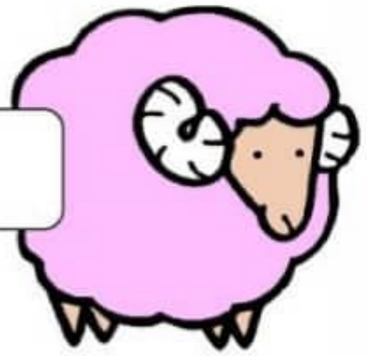
Liquor: 15-20 l



Paper: 10-20 l

Sugar: 100 l

Margarine: 40-60 l



Wool: 100 l

Coal: 20-30 l

Cellulose: 80-150 l

AGRICULTURAL WASTEWATER

Nonpoint source controls

Sediment (loose soil) washed off fields is the largest source of agricultural pollution. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour ploughing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer; animal manure; or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients.

Point source wastewater treatment

Farms with large livestock and poultry operations, such as factory farms, are called *concentrated animal feeding operations* or *confined animal feeding operations* in the US and are being subject to increasing government regulation.

Animal slurries are usually treated by containment in lagoons before disposal by spray or trickle application to grassland.

Constructed wetlands are sometimes used to facilitate treatment of animal wastes, as are anaerobic lagoons. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologic ally sterile and friable manure for soil improvement.

HAITI CHOLERA OUTBREAK

The **Haiti cholera outbreak** began in late October 2010 in the rural area of Haiti about 100 kilometres north of the capital, Port-au-Prince, killing 4,672 people by March 2011 and hospitalising thousands more. The outbreak followed a powerful earthquake which devastated the country on 12 January 2010. By March 2011, 252,640 cases had been reported. By the first 10 weeks of the epidemic, cholera spread to all of Haiti's 10 departments or provinces.

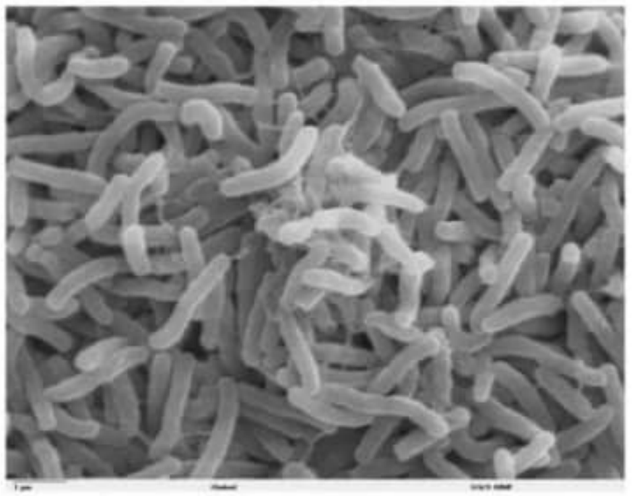


Image of *Vibrio cholerae*

Earthquake in the Haiti - 12.01.2010.

In November 2010, the first cases of cholera were reported in the Dominican Republic and a single case in Florida, US.
As of late September, 2011, some 6,435 deaths have been reported and is expected to continue rising.

Patients of cholera in Haiti

CATEGORIES OT THE WASTWATER

Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated.

Surface water seeps through the soil and becomes groundwater.

Conversely, groundwater can also feed surface water sources.

Sources of surface water pollution are generally grouped into two categories based on their origin.

Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch.

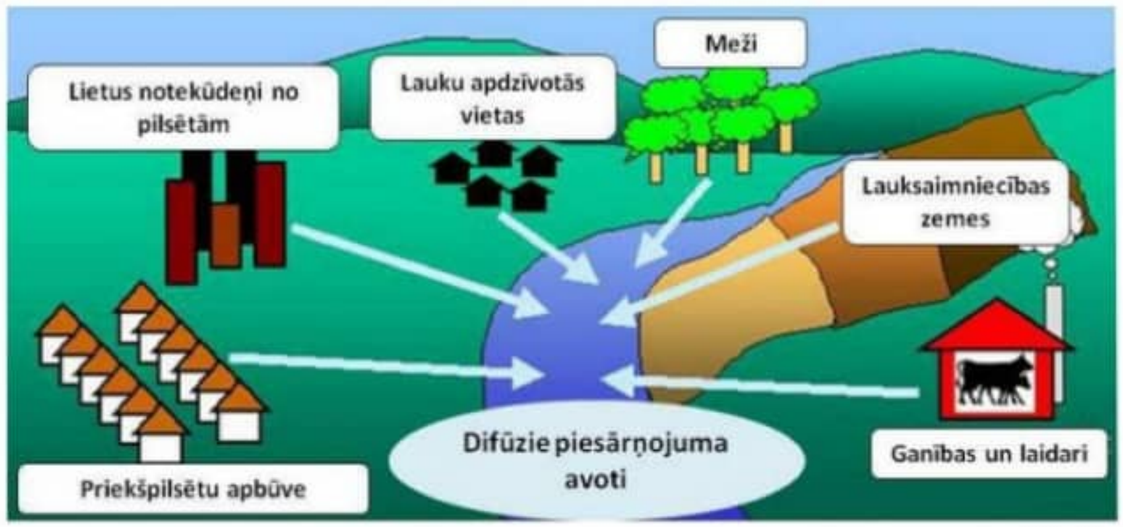
Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

Non-point source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often the cumulative effect of small amounts of contaminants gathered from a large area.

A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in storm water from "sheet flow" over an agricultural or a forest are also cited as examples of NPS pollution.

Contaminated storm water washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of NPS pollution. However, this runoff is typically channelled into storm drain systems and discharged through pipes to local surface waters, and is a point source.

However where such water is not channelled and drains directly to ground it is a non-point source.



Burkholderia pseudomallei (also known as *Pseudomonas pseudomallei*) is a Gramm-negative, bipolar, aerobic, motile rod-shaped bacterium. It infects humans and animals and causes the disease melioidosis.
It is also capable of infecting plants.
B. pseudomallei measures 2-5 μm in length and 0.4-0.8 μm in diameter and are capable of self-propulsion using flagellae. The bacteria can grow in a number of artificial nutrient environments.
Bacteria produce both exo- and endo-toxins. The role of the toxins identified in the process of melioidosis symptom development has not been fully elucidated.

Salmonella is a genus of rod-shaped, Gram-negative, non-spore-forming, predominantly motile enterobacteria with diameters around 0.7 to 1.5 μm, lengths from 2 to 5 μm, and flagella which grade in all directions. They obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes. *Salmonella* is closely related to the *Escherichia* genus and are found worldwide in cold- and warm-blooded animals (including humans), and in the environment. They cause illnesses like typhoid fever and food-borne illness.

Giardia lamblia is a flagellated protozoan parasite that colonizes and reproduces in the small intestine, causing giardiasis. The giardia parasite attaches to the epilhelium by a ventral adhesive disc, and reproduces via binary fission. Giardiasis does not spread via the bloodstream, nor does it spread to other parts of the gastro-intestinal tract, but remains confined to the lumen of the small intestine. Chief pathways of human infection include ingestion of untreated sewage, a phenomenon particularly common in many developing countries; contamination of natural waters also occurs in watersheds where intensive grazing occurs.

MUNICIPAL WASTEWATER

Municipal wastewater is mixture of the household and industrial wastewaters with or without precipitation water.

Content of the municipal wastewater:

- Different solid participles
- N and P compounds
- Stable organic substances
- Ions of the metals
- Microorganisms
- Other compounds

- Biochemical oxygen demand (BOD) - 250 mg/l
- Chemical oxygen demand (COD) - 500 mg/l
- Ammonia (NH_4-N) - 40 mg/l
- Total nitrogen, including ammonia (NH_4-N) - ($_{Ptot.}$) - 8 mg/l
- Total phosphorus - 8 mg/l
- Participle matter (PM)
- pH 3-8
- Total dissolved substances - 200-1000 mg/l

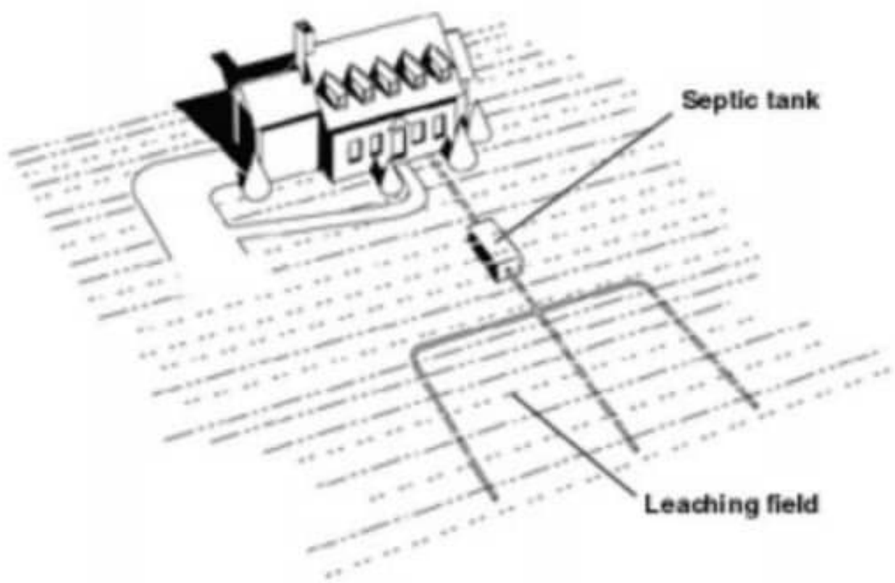
DOMESTIC SEWAGE

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including:

- utilizing a green infrastructure approach to improve stormwater management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant;
- repair and replacement of leaking and malfunctioning equipment;
- increasing overall hydraulic capacity of the sewage collection system (often a very expensive option.

A household or business not served by a municipal treatment plant may have an individual septic tank, which treats the wastewater on site and discharges into the soil. Alternatively, domestic wastewater may be sent to a nearby privately owned treatment system (e.g. in a rural community).

The septic tank partially installed in the ground



Septic drain field

SOIL POLLUTING

If pollutants are on surface of soil, there are three possibilities:

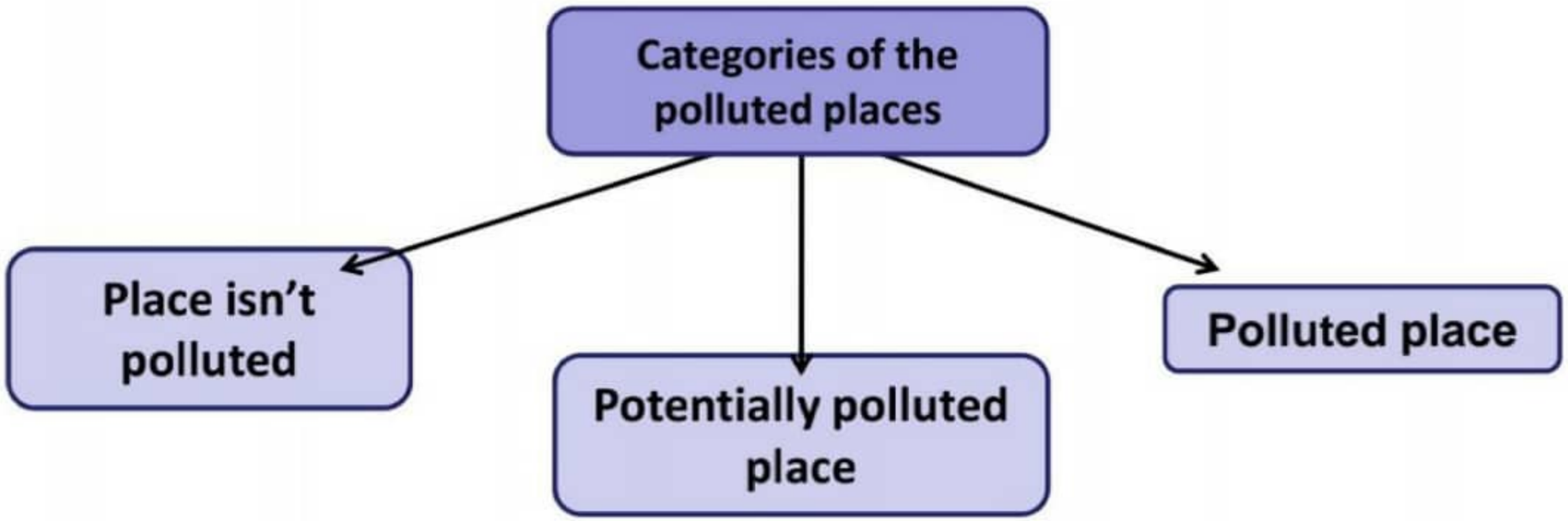
1) **Polluting substance are distributed or wash away, for example, with rain water, therefore damage for soil is minimal**

2) **Polluting substance (if evaporable) can evaporate, without polluting soil surface and deeper layers, but polluting the air**

3) **Polluting substance can infiltrate into soil, similarly, as water infiltrates into soil, therefore soil will be polluted.**

POLLUTED PLACES

Polluted place – soil, entrails of the Earth, water, sludge, buildings and activities indoor, production units or other objects, where are used polluting substances.



Ministry of Environment and Regional development from 2004 has data base, with information about approximately 3500 potentially polluted place and polluted places in Latvia.

GOUDRON PONDS

Goudron (flux oil; oil tar) ponds are situated in area, used for extraction of artesian drinking water, therefore threat supplement Riga city with high quality of drinking water.

Polluted volume of underground waters is **108 000 m^3**, but total pollution distribution areal is more as **280 ha.**

Pollution of the goudron ponds by infiltration is reach 70-90 m deep layers, where are reserves of ground and artesian water. Pollution moves in direction of river Gauja with speed 25-35 m/y.

Without recovery polluted water reach river Gauja in 65 years.

Calculations demonstrate, that recovery expenses will be approximately **20 378 000 Ls.**

TOXIC LIQUID WASTE LANDFILL IN OLAINE

Toxic liquid waste landfill is situated approximately 4 km from Olaine. That site seriously threat towns Jaunolaine and Olaine by groundwater polluting.

On 1973-1980 there has been deposited liquid, pseudo-solid and solid waste from factory "Latbiofarm" and "Biolar" in amount as far as 16 000 t/y.
Toxic substances: ammonia chloride, pyridine, butanol, isopropanol, sodium acetate and other toxic substances.

Soil pollution

Soil contamination or soil pollution is caused by the presence of human-made chemicals or other alteration in the natural soil environment.

This type of contamination typically arises from the failure caused by corrosion of underground storage tanks (including piping used to transmit the contents), application of pesticides, oil and fuel dumping, disposal of coal ash, leaching of wastes from landfills or direct discharge of industrial wastes to the soil.

The most common chemicals involved are petroleum hydrocarbons, lead, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

According to a scientific sampling 100,000 square kilometers of China's cultivated land have been polluted, with contaminated water being used to irrigate a further 21,670 square kilometers and another 1,300 square kilometers covered or destroyed by solid waste. In total, the area accounts for one-tenth of China's cultivatable land, and is mostly in economically developed areas.

An estimated 12 million tonnes of grain are contaminated by heavy metals every year, causing direct losses of 20 billion yuan (US$ 2.57 billion).

Excavation showing soil contamination at a disused gasworks

Pesticides

Food and Agriculture Organization (FAO) has defined the term of *pesticide* as:

any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

Type of Pesticide	Target Pest Group
Algicides	Algae
Avicides	Birds
Bactericides	Bacteria
Fungicides	Fungi
Insecticides	Insects
Miticides or acaricides	Mites
Molluscicides	Snails
Nematicides	Nematodes
Rodenticides	Rodents
Virucides	Viruses

Environmental and economical effect by pesticides use

Environmental effect

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistant organic pollutants and contribute to soil contamination.

In addition, pesticide use reduces biodiversity, reduces nitrogen fixation, contributes to pollinator decline, destroys habitat (especially for birds), and threatens endangered species.

Pests can develop a resistance to the pesticide (pesticide resistance), necessitating a new pesticide. Alternatively a greater dose of the pesticide can be used to counteract the resistance, although this will cause a worsening of the ambient pollution problem.

Economics

Harm Annual US Cost Public Health $1.1 billion Pesticide Resistance in Pest $1.5 billion Crop Losses Caused by Pesticides $1.4 billion Bird Losses due to Pesticides $2.2 billion Groundwater Contamination $2.0 billion Other Costs $1.4 billion **Total Costs $9.6 billion** Human health and environmental cost from pesticides in the United States is a total of $9.6 billion.

Additional cost includes the registration process and the cost of purchase pesticides. The registration process can take several years to complete the 70 different types of field test and can cost between $50–70 million for a single pesticide. Annually the United States spends $10 billion on pesticides.

Harm	Annual US Cost
Public Health	$1.1 billion
Pesticide Resistance in Pest	$1.5 billion
Crop Losses Caused by Pesticides	$1.4 billion
Bird Losses due to Pesticides	$2.2 billion
Groundwater Contamination	$2.0 billion
Other Costs	$1.4 billion
Total Costs	**$9.6 billion**

Renewable Energy Sources

Definition of Renewable Energy :

You have already known about non-renewable or exhaustible sources of energy. Most of us rely heavily on the use of non-renewable energy resources such as coal, oil and natural gas for our daily need but we know that these resources are finite in nature and eventually the day will come when they will vanish for ever. Before that they will become too expensive and also damaging for the environment. Sooner or later we have to think about using alternative energy resources which are renewable, may last forever.

The increasing population and change in our life style make great demand for energy resources. This ever increasing demand puts great pressure on non-renewable conventions energy sources and makes it necessary that we should look for other alternative energy resources. The sources like sun and wind can never be exhausted and are thus known as renewable sources of energy; they cause no emission of poisonous gases and are available locally. They are widely available and potential source of clean and limitless sources of energy. In this lesson you will study about such renewable sources of energy.

Classification of Energy:

I. Commercial Energy and Non Commercial Energy:

Commercial Energy:

The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population. Examples: Electricity, lignite, coal, oil, natural gas etc.

Non-Commercial Energy:

The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels. Non-commercial energy is

often ignored in energy accounting. Example: Firewood, agro waste in rural areas; solar energy for water heating, electricity generation, for drying grain, fish and fruits; animal power for transport, threshing, lifting water for irrigation, crushing sugarcane; wind energy for lifting water and electricity generation.

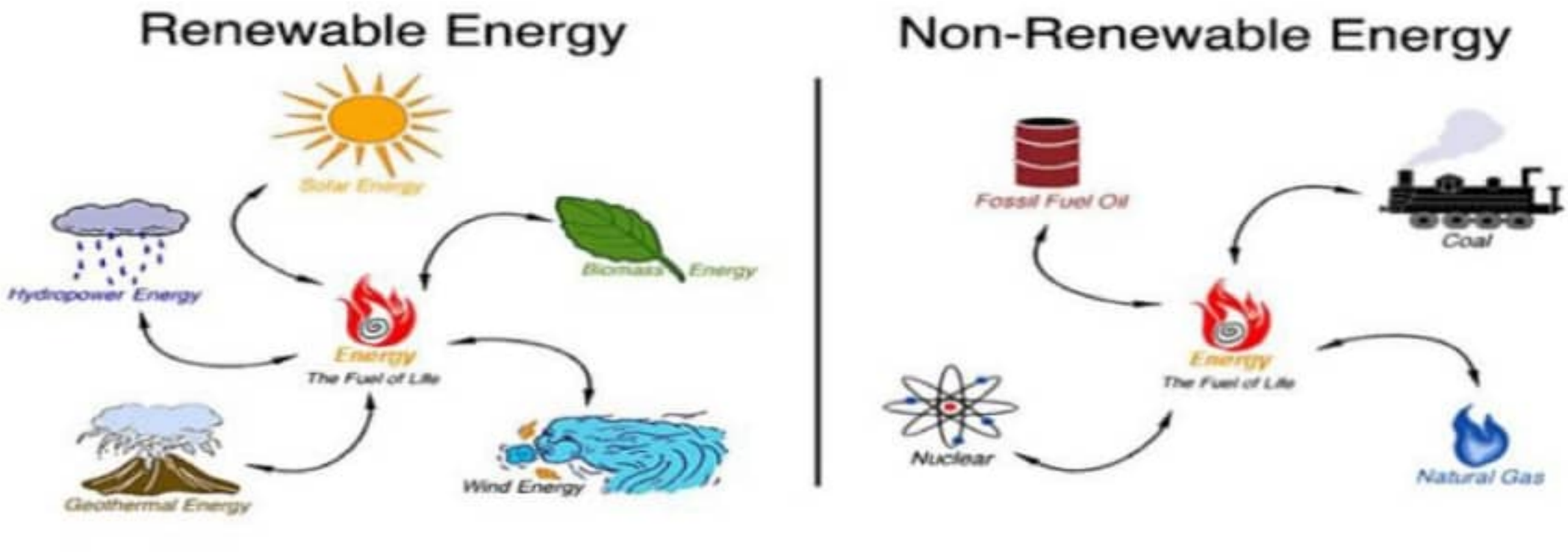
Conventional and Non-conventional energy resources:

Conventional Energy:
Conventional energy resources which are being traditionally used for many decades and were in common use around oil crisis of 1973 are called conventional energy resources, e.g., fossil fuel, nuclear and hydro resources.

Non-conventional energy:
Non-conventional energy resources which are considered for large – scale use after oil crisis of 1973, are called non-conventional energy sources, e.g., solar, wind, biomass, etc.

Renewable and Non-RenewableEnergy:

Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples ofrenewableresources include wind power, solar power, geothermal energy, tidal power andhydroelectric power. The most important feature of renewable energy is that it can be harnessed without the release of harmfulpollutants.Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time.



Solar radiation & Collectors

Solar Radiation Through Atmosphere:

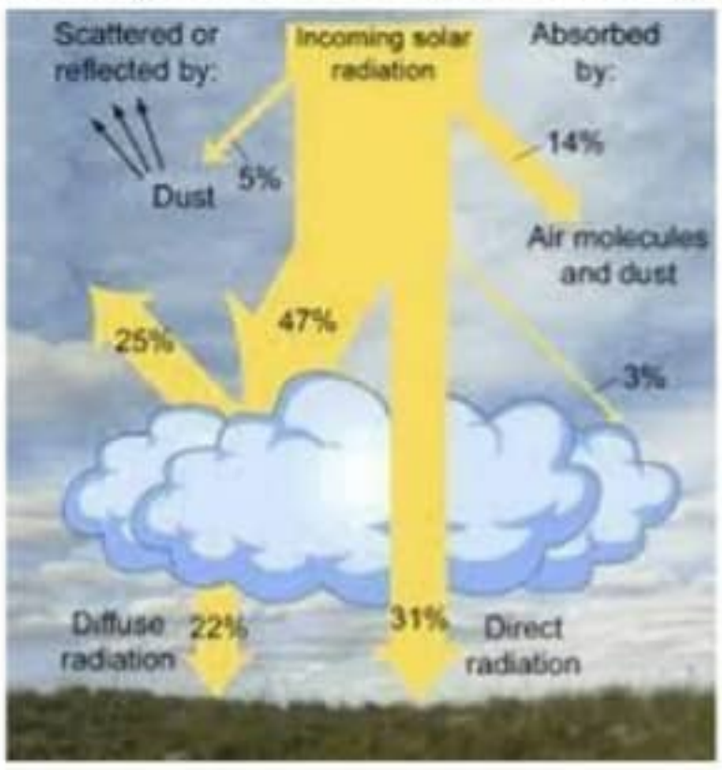
Solar energy, received in the form of radiation, can be converted directly or indirectly in to other forms of energy, such as heat and electricity. The major draw backs of the extensive application of solar energy of

1. the intermittent and variable manner in which it arrives at the earth's surface and
2. the large area require to collect the energy at a useful rate.

Energy is radiated by the sun as electromagnetic waves of which 99% have wave lengths in the range of 0.2 to 4.0 micro meter (1 micro meter = 10-6 meter)

Solar energy reaching the top of the earth's atmosphere consists of about

- 8% ultra violet radiation [short wave length >0.39 micrometer]
- 46% visible light [0.39 to 0.78 micrometer]
- 46 % infrared [0.78 micro meter above]



About 29 percent of the solar energy that arrives at the top of the atmosphere is reflected back to space by clouds, atmospheric particles, or bright ground surfaces like sea ice and snow. This energy plays no role in Earth's climate system. About 23 percent of incoming solar energy is absorbed in the atmosphere by water vapor, dust, and ozone, and 48 percent passes through the atmosphere and is absorbed by the surface. Thus, about 71 percent of the total incoming solar energy is absorbed by the Earth system.

Of the 340 watts per square meter of solar energy that falls on the Earth, 29% is reflected back into space, primarily by clouds, but also by other bright surfaces and the atmosphere itself. About 23% of incoming energy is absorbed in the atmosphere by atmospheric gases, dust, and other particles. The remaining 48% is absorbed at the surface.

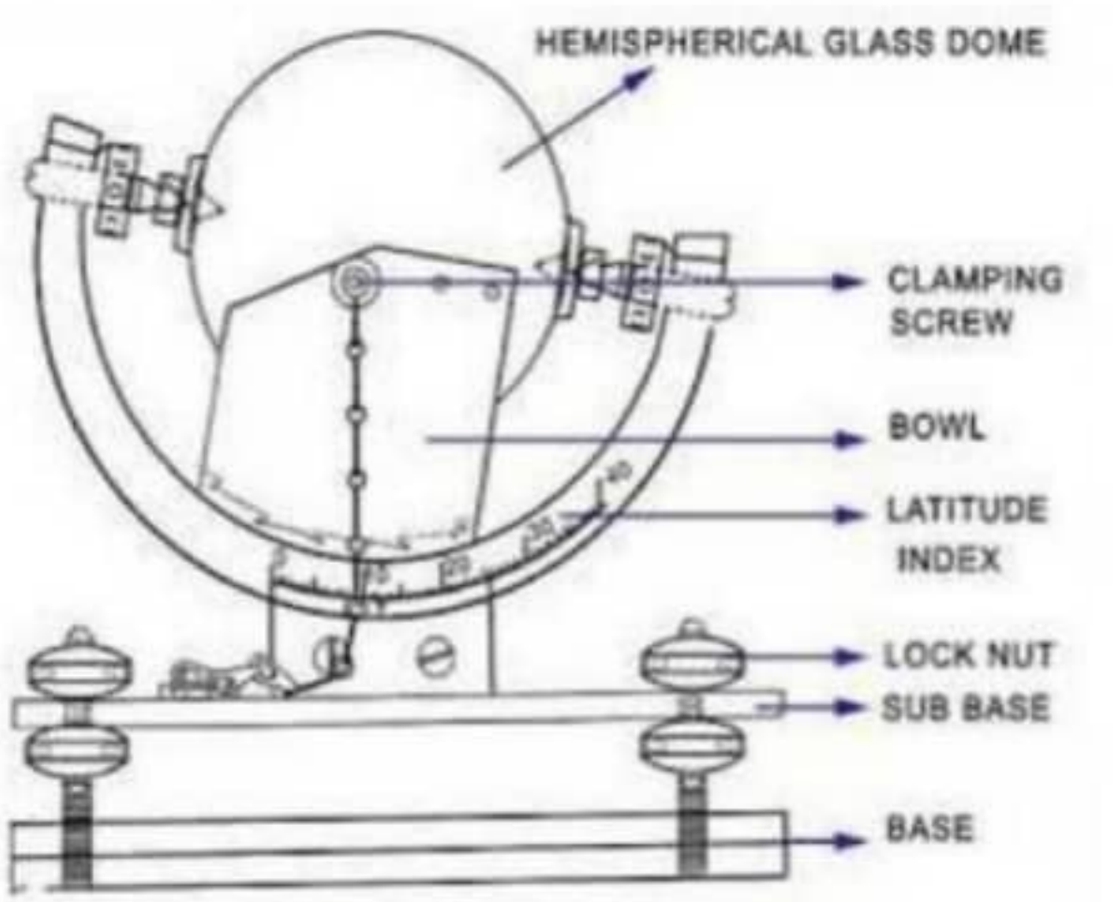
Terrestrial Solar Radiation:

Measurement of Solar Radiation:

The measurement of solar radiation is performed with the help of sunshine recorders, Pyranometres and Pyrheliometers.

Sunshine recorder:

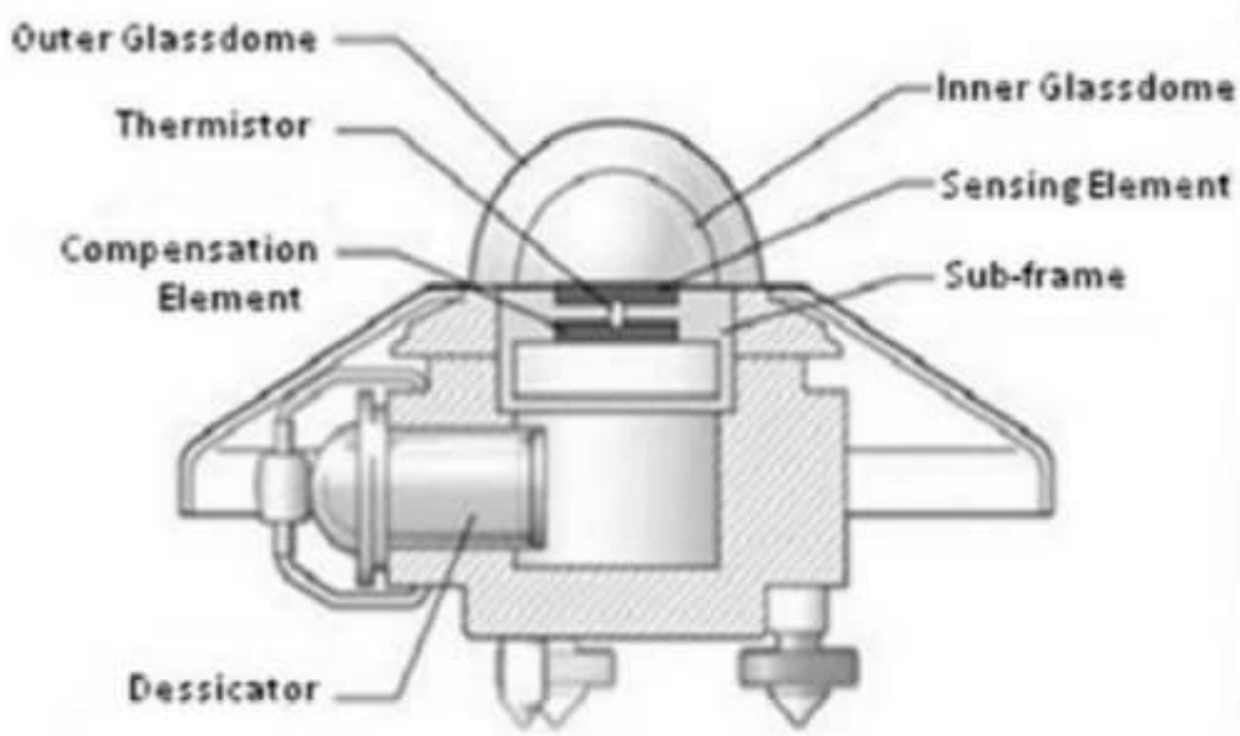
The instrument measures the duration in hours of bright sunshine during the course of a day. It consists of a glass sphere (about 10 cm in diameter) mounted on its axis parallel to that of the earth within a spherical section (bowl). The bowl and glass sphere are arranged in such a way That the sun's ray are Focused sharply at a spot on a card held in a groove in the bowl. As the sun moves, the focused bright sunshine burns a path along this paper. The length of the trace thus obtained on the paper is the measure of the duration of the bright sunshine.



CAMPBELL - STOKES SUNSHINE RECORDER

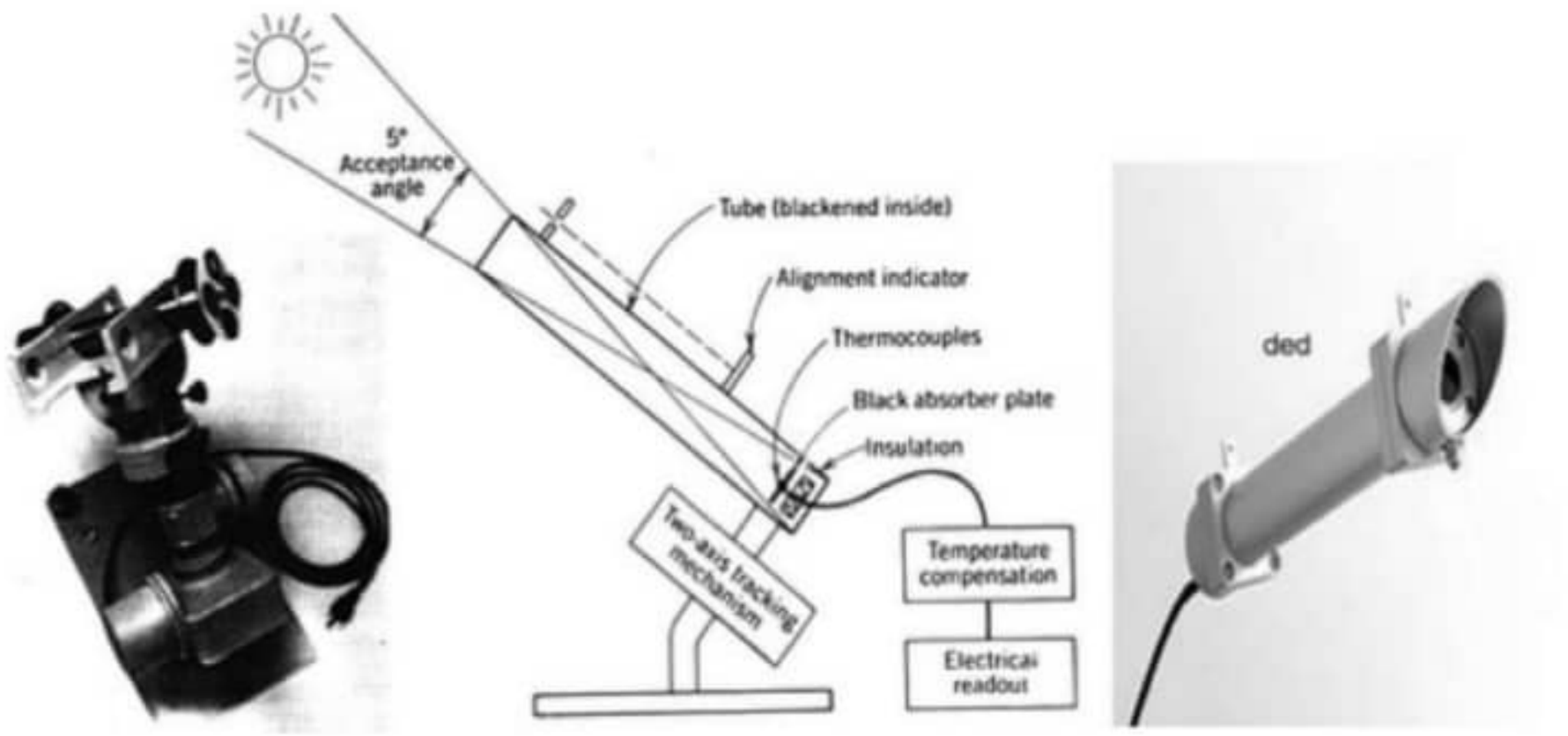
Pyranometres:

A precision pyranometer is designed to respond all wave lengths of radiation and hence measures accurately the total power in the incident spectrum. It contains a thermo pile whose sensitive surface consists of circular,blackened,hot junctions exposed to the sun. The cold junction being completely shaded. The temperature difference between the hot and cold junctions is the function of radiation falling on the sensitive surface. The sensing element is covered with two concentric hemi spherical glass domes to protect from rain and wind. A radiation shield surrounding the outer dome and coplanar with the sensing lement, prevents direct sola rradiation from the base of the heating element.



Pyrheliometers:

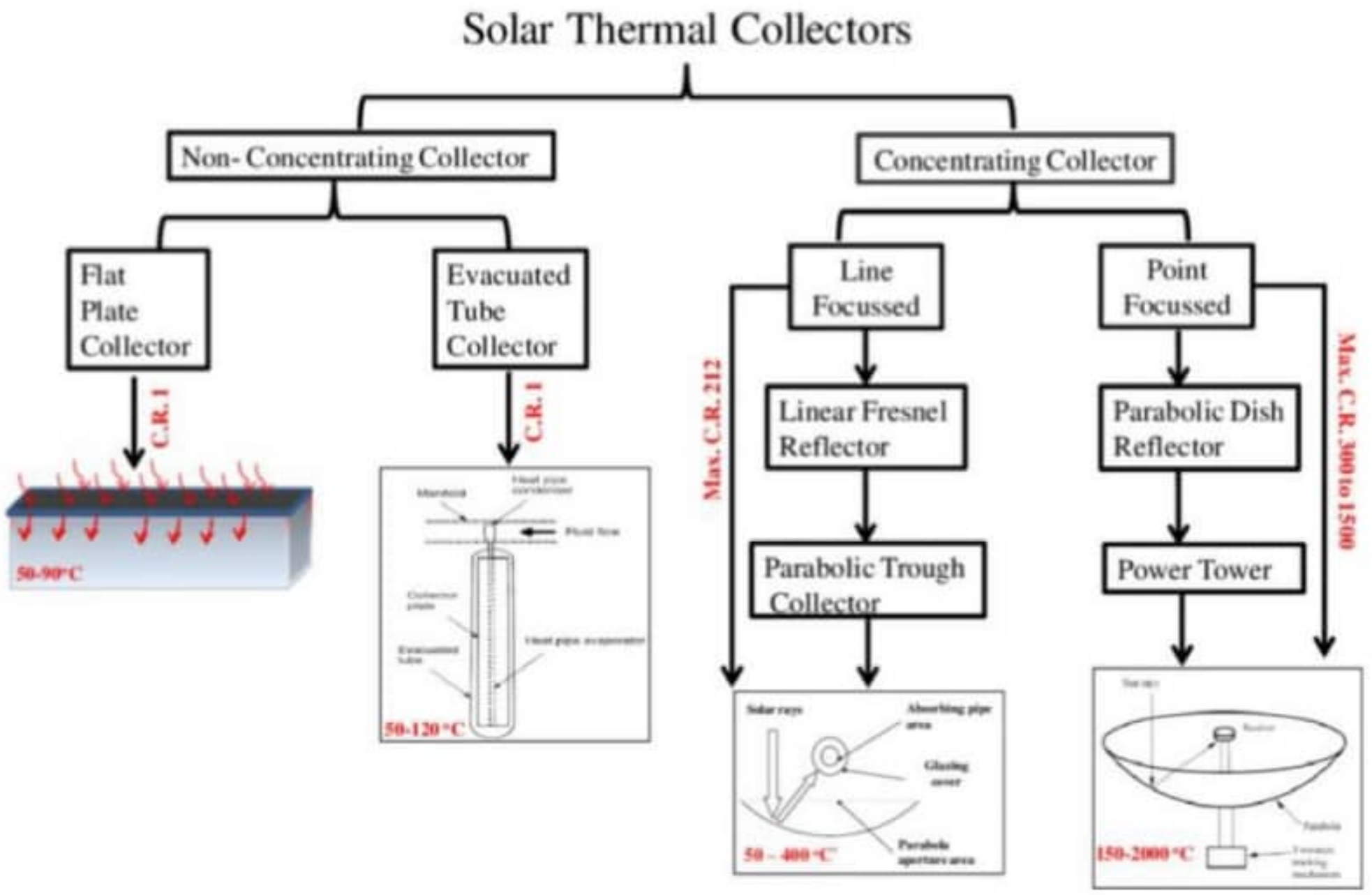
The long collimator tube collects the beam radiation whose field of view is limited to a solid angle of 5.50. The diaphragms are present inside the tube.The inside of the tube is blackened to absorb any radiation incident at angles out side the collection solid angle. At the base of the tube a wire wound thermo pile having a sensitivity of approximately 8μ W/m2 and an output impendence of approximately 200Ω is provided. The tube is sealed with dry air to eliminate absorption of beam radiation with in the tube by water vapour.



Solar Collectors:

Solar thermal energy is the most readily available source of energy. The Solar energy is most important kind of non-conventional source of energy which has been used since ancient times, but in a most primitive manner. The abundant solar energy available is suitable for harnessing for a number of applications. The application of solar thermal energy system ranges from solar cooker of 1 kw to power plant of 200MW. These systems are grouped into low temperature (<150oC), medium temperature (150-300oC) applications.

Solar collectors are used to collect the solar energy and convert the incident radiations into thermal energy by absorbing them. This heat is extracted by flowing fluid (air or water or mixture with antifreeze) in the tube of the collector for further utilization in different applications. The collectors are classified as;



Flat Plate Collectors:

The flat plate collector is located in a position such that its length is aligned with longitude and is suitably tilted towards south to have maximum collection. The schematics of flat plate collectors are shown in the figure (a) and (b). It consists of a black coated plate made of metal or plastic, which absorbs all the solar radiation incident on it and converts into heat. This plate is known as the absorber. Fluid channels are welded below the absorber for carrying a heat transfer fluid generally water. This transport fluid transports the heat from the absorber into the utilisation purposes.

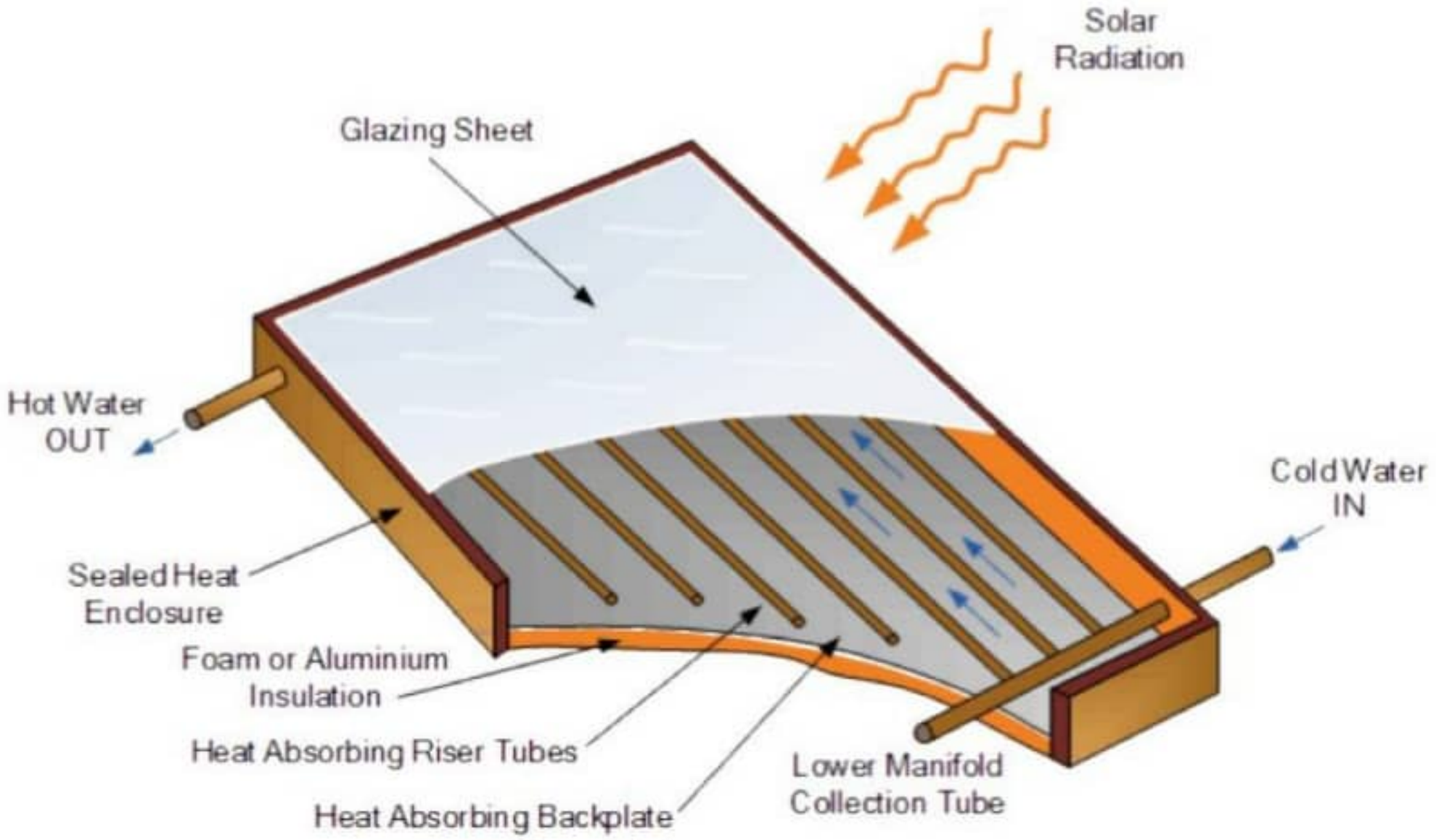
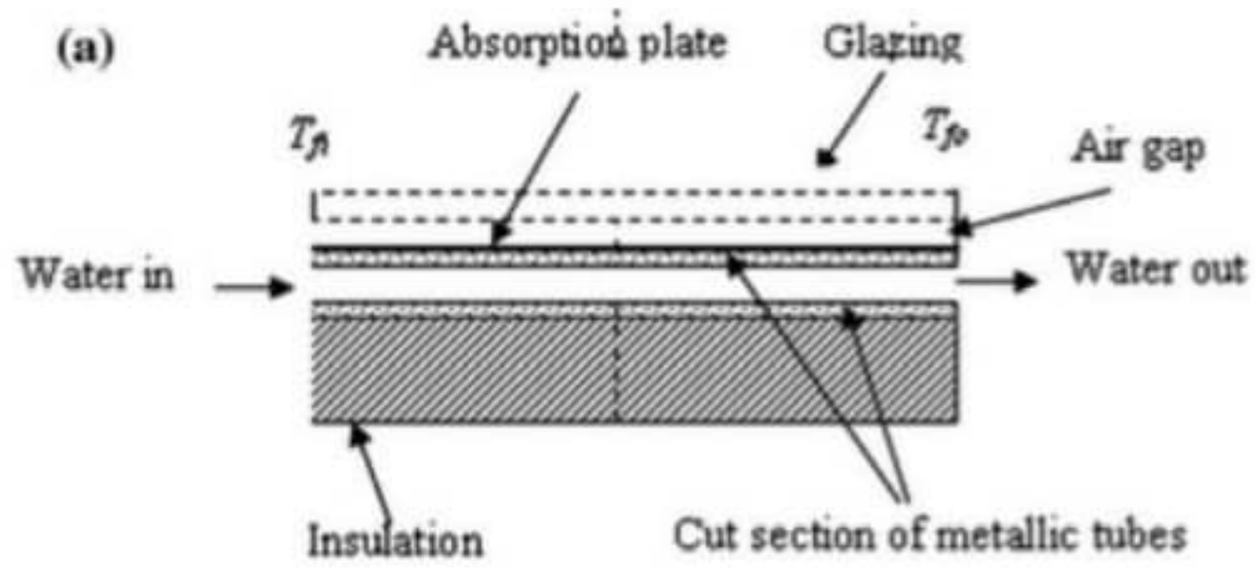

Solar
Radiation
Glazing Sheet
Hot Water
OUT
Cold Water
IN
Sealed Heat
Enclosure
Foam or Aluminium
Insulation
Heat Absorbing Riser Tubes
Lower Manifold
Collection Tube
Heat Absorbing Backplate

figure (a)


(a)
Absorption plate
Glazing
T_{fi}
T_{fo}
Air gap
Water in
Water out
Insulation
Cut section of metallic tubes

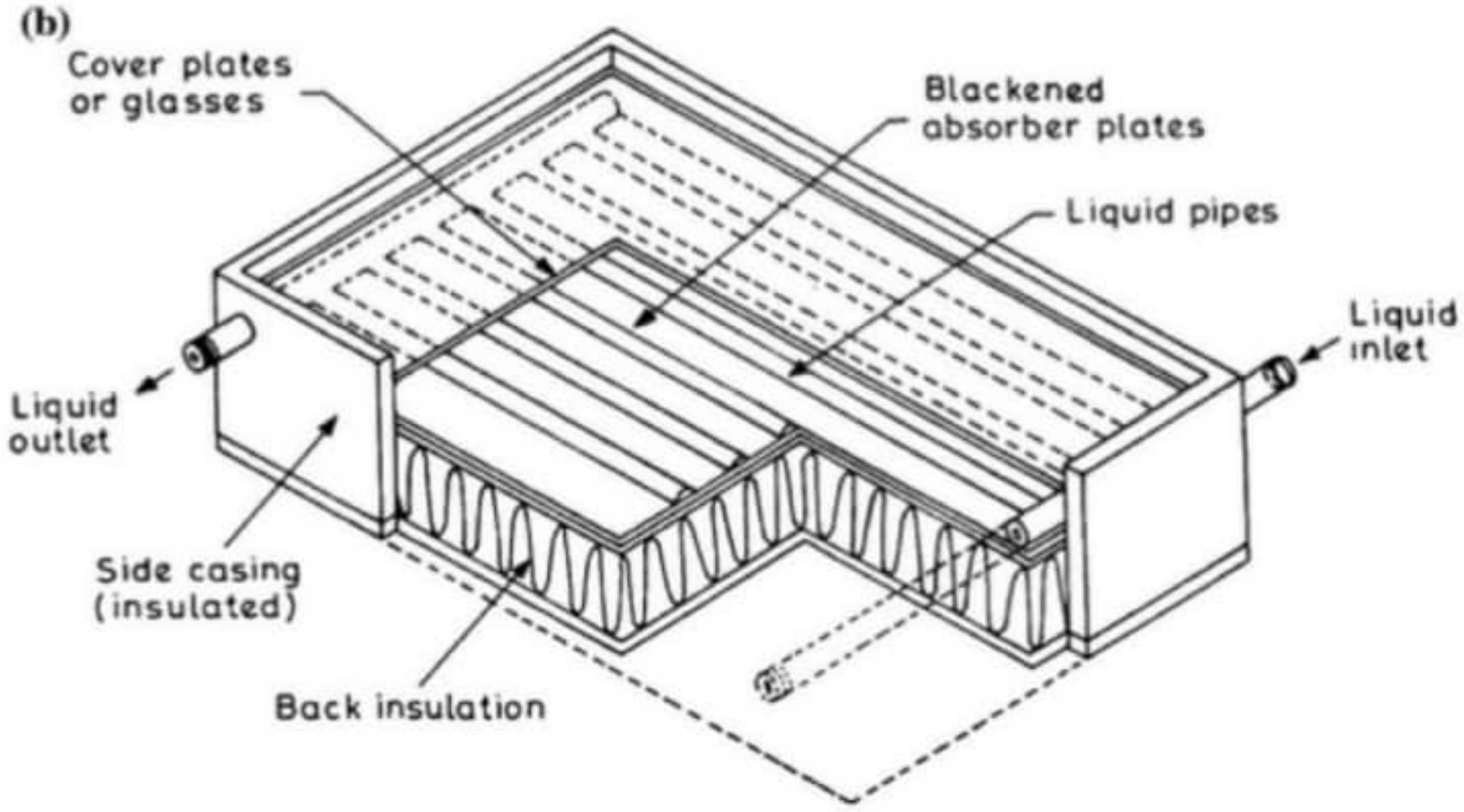

(b)
Cover plates
or glasses
Blackened
absorber plates
Liquid pipes
Liquid
inlet
Liquid
outlet
Side casing
(insulated)
Back insulation

Figure (b)

To reduce the heat losses, the back side and sides of the collector (below the absorber) are covered with insulation. The front above of the absorber is covered with one or two transparent glass sheets. The whole thing is sealed in a box or some sort of casing. The working of the collector basically depends upon the greenhouse effects. Flat plate collectors can convert solar radiation into heat upto maximum 1000C. Air heating solar collectors are mostly used for agricultural drying and space heating applications. The basic advantages are low sensitivity to leakage, less corrosion and no need for additional heat exchanger. The main disadvantage is the requirement of larger surface area for heat transfer and higher flow rate.

SOLID WASTE MANAGEMENT

- *Solid waste management*
- *Types of waste*
- *Functional element of waste management*
- *Integrated solid waste management*
- *Segregation*
- *questions*

1. INTRODUCTION

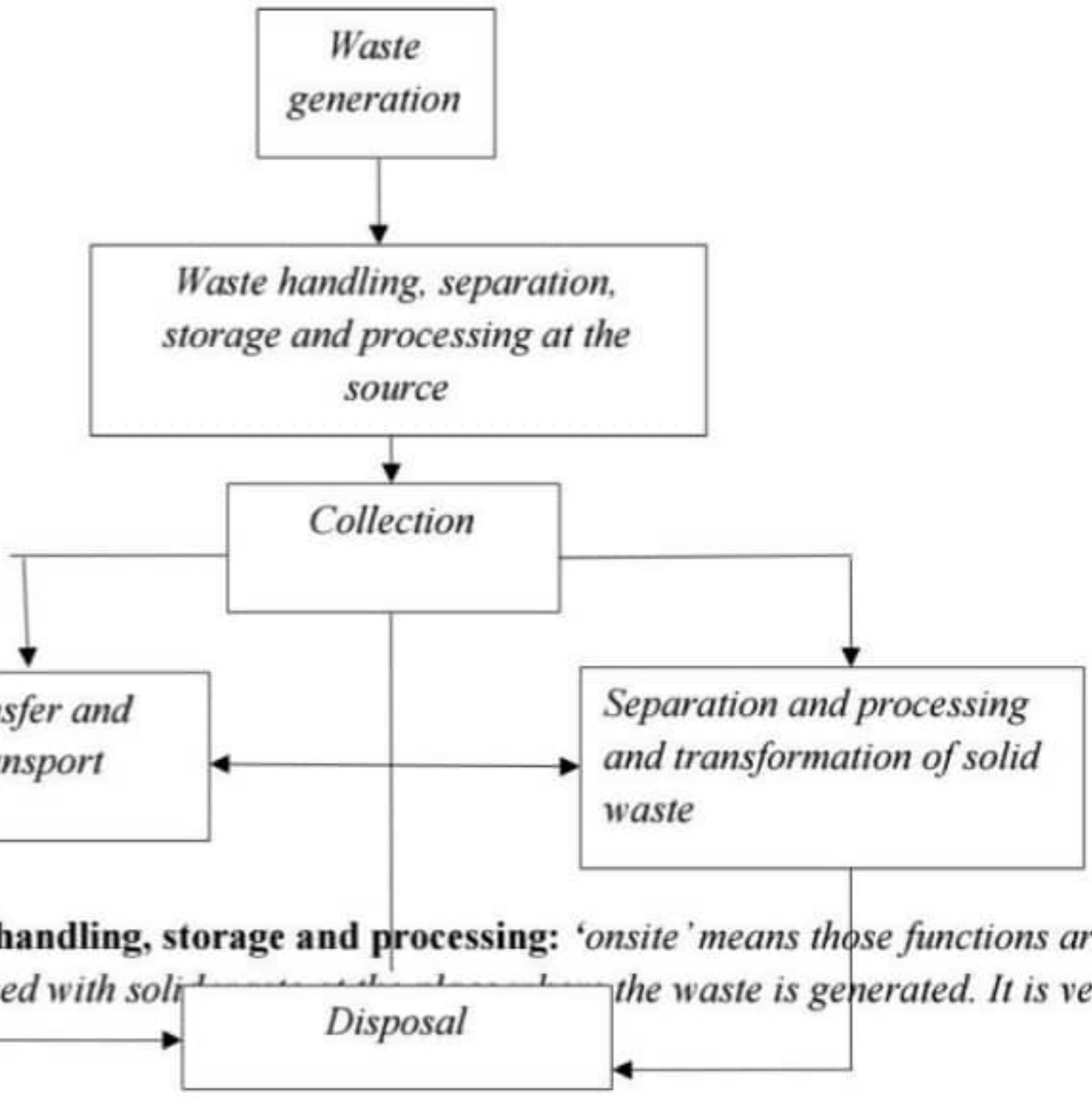
Solid waste: *it includes all the useless solid materials from municipal, industrial, agricultural, medical and sewage.*

2. SOLID WASTE MANAGEMENT

Solid waste management can be defined as the method of

i) Onsite handling, storage and processing.
ii) Collection
iii) Transfer and transport
iv) Resource recovery and processing
v) Disposal

Urban are waste management:



i) **Onsite handling, storage and processing:** *'onsite' means those functions are concerned with soli the waste is generated. It is very*

first step in the waste management. 'Handling' means the separation of waste into their different types.

Onsite storage means the temporary collection of waste at the household level it is important that waste stored in proper container.

The size of the containers or dustbins especially those used for food waste should be leak proof, tight lid, long lasting and should be sufficient to hold at least waste per day level.

The proper location of storage container and the frequency and time of emptying are important factors for onsite storage.

3. TYPES OF WASTE:

***Biodegradable waste**: food and kitchen waste, green waste, paper (can be recycled)*

***Recyclable material:** paper, glass bottles, cans, metals, certain plastics, etc.*

***Inert waste**: construction and demolition waste, dirt, rocks, debris.*

***Composite wastes**: waste closing, Tetra Packs, waste plastics such as toys.*

***Domestic hazardous waste & toxic waste**: medication or drugs, E-waste, paints, chemicals, light bulbs or fluorescent tubes, spray cans, fertilizers and pesticides and their containers, batteries, shoe polish materials. Etc.*

3.1 **Biodegradable waste:** *Biodegradable waste is a type of waste, typically originating from plant or animal sources, which may be degraded by other living organisms. Wastes that cannot be broken down by other living organisms are called non-biodegradable. Biodegradable waste can be commonly found in municipal solid waste as green waste, food waste, paper waste, and biodegradable plastics. Other biodegradable wastes include human waste, manure, sewage, slaughterhouse waste. In the absence of oxygen much of this waste will decay to methane by anaerobic digestion. Biodegradable waste can often be used for composting or must be a resource for heat, electricity and fuel in future. This produces additional biogas and still delivers the compost for the soil.*

3.2 **Construction waste**: *Construction waste consists of unwanted material produced directly or incidentally by the construction or industries. This includes building materials such as insulation, nails, electrical wiring, as well as waste originating from site preparation such as dredging, materials, tree stumps, and rubble. Construction waste may contain lead, asbestos, or other hazardous substances. Much building waste is made up of materials such as bricks, concrete and wood damaged or unused for various reasons during construction. Observational research has shown that this can be as high as 10 to 15 % of the materials that go into a building, a much higher percentage than the 2.5-5 % usually assumed by quantity surveyors and the construction industry. Since considerable variability exists between construction sites, there is much opportunity for reducing this waste. Plasterboard is broken down in landfill conditions releasing hydrogen sulphide, a toxic gas. There is the potential to*

recycle many elements of construction waste. Often roll-off containers are used to transport the waste. Rubble can be crushed and reused in construction projects. Waste wood can also be recovered and recycled. Government or local authorities often make rules about how much waste should be sorted before it is hauled away to landfills or other waste treatment facilities. Some hazardous materials may not be moved, before the authorities have ascertained that safety guidelines and restrictions have been followed. Among their concerns would be the proper handling and disposal of such toxic elements as lead, asbestos or radioactive materials.

4. THE FUNCTIONAL ELEMENTS OF SOLID WASTE

4.1Waste generation - encompasses activities in which materials are identified as no longer being of value and are either thrown out or gathered together for disposal.

4.2 Collection - the functional element of collection includes not only the gathering of solid waste and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be materials processing facility, a transfer station or a landfill disposal site.

4.3Waste handling and separation, storage and processing at the source - involves activities associated with waste management until the waste is placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Separating different types of waste components is an important step in the handling and storage of solid waste at the source.

4.4Separation and processing and transformation of solid wastes - the types of means and facilities that are now used for the recovery of waste materials that have been separated at the source include curb side collection, drop off and buy back centres. The separation and processing of wastes that have been separated at the source and the separation of commingled wastes usually occur at a materials recovery facility, transfer stations, combustion facilities and disposal sites.

4.5Transfer and transport - this element involves two main steps. First, the waste is transferred from a smaller collection vehicle to larger transport equipment. The waste is then transported, usually over long distances, to a processing or disposal site.

4.6Disposal - today, the disposal of wastes by land filling or land spreading is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from material recovery facilities, residue from the combustion of solid waste, compost, or other substances from various solid waste processing facilities.

4.7A modern sanitary landfill is not a dump; it is an engineered facility used for disposing of solid wastes on land without creating nuisances or hazards to public health or safety, such as the breeding of insects and the contamination of ground water.

4.8Energy generation - municipal solid waste can be used to generate energy. Several technologies have been developed that make the processing for energy generation cleaner and more economical than ever before, including landfill gas capture, combustion, pyrolysis, gasification.

5. INTEGRATED MANAGEMENT OF SOLID WASTE:

- *Integrated Solid Waste Management (ISWM) is a comprehensive waste collection, treatment, recovery and disposal method that aims to provide environmental sustainability, economic affordability and social acceptance for any specific region.*
- *Integrated solid waste management is therefore the process of optimizing the waste management system as a whole with application of a variety of suitable technologies.*
- *It includes technical as well as managerial aspects of solid waste management.*
- *Integrated solid waste management seeks to integrate various aspects of SWM by involving all stakeholders to optimize all the elements of the waste management system as a whole.*
- *Integrated solid waste management is intended to help guide decisions about the generation of wastes, recycling of materials, and ultimate disposal of waste residues.*

5.1 Reduce

Waste minimisation is the process and the policy of reducing the amount of waste produced by a person or a society. Waste minimisation involves efforts to minimise resource and energy use during manufacture. For the same commercial output, usually the fewer materials are used, the less waste is produced. Waste minimisation usually requires knowledge of the production process.

5.2 Reuse

To reuse is to use an item more than once. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a different function .By taking useful products and exchanging them, without reprocessing, reuse help save time, money, energy, and resources. In broader economic terms, reuse offers quality products to people and organizations with limited means, while generating jobs and business activity that contribute to the economy. Historically, financial motivation was one of the main drivers of reuse. In the developing world this driver can lead to very high levels of reuse, however

rising wages and consequent consumer demand for the convenience of disposable products has made the reuse of low value items such as packaging uneconomic in richer countries, leading to the demise of many reuse programs. Current environmental awareness is gradually changing attitudes and regulations, such as the new packaging regulations, are gradually beginning to reverse the situation. One example of conventional reuse is the doorstep delivery of milk in refillable bottles; other examples include the retreading of tires and the use of returnable/reusable plastic boxes, shipping containers.

5.3 Recycling

Recycling of materials and substances contained in solid waste is very simple in theory but extremely hard in practice. People have always collected utilisable and valuable materials (e.g. metals) from waste and used them in industry because it is cheaper than extracting them from raw materials. It is also useful to separate cheap materials from waste because they still have some value (old newspapers to produce pulp and news paper) or it is inconvenient to throw them away (bottles). Economic reasons are decisive for the reuse of materials. For the time being, to produce glass from natural raw materials is cheaper than from discarded, used glass, and using glass chippings to replace stones in the road or street construction consumes much more energy. In many countries regulations require sorting waste at the source. Residents need to sort waste into such types as food scraps, paper, ash and glass.

5.4 composting of organic solid waste

Composting is a process in which organic waste is collected in an open pit and is decomposed by natural biological processes. Both human waste and organic household waste can be composed.

5.5 Incinerations

Incineration means burning in controlled and managed process, usually at the high temp

6. SEGREGATION

Waste segregation refers to the separation of wet waste and dry waste, the purpose is to recycle dry waste easily and to use wet waste as compost.

MINING AND DEFORESTATION

Learning Objective

- *Deforestation*
- *Causes of deforestation*
- *Major effects of deforestation*
- *Mining*
- *Types of mining*
- *Effect of mining on environment*
- *Regulation and governance*
- *questions*

1. INTRODUCTION

1. *Forest are burned or cut for clearing of land for agriculture ,harvesting for wood and timber , development and expansion of cities .These economic gains are short term where as long term effects of deforestation are irreversible*
2. *Deforestation rate is relatively low in temperate countries than in tropics If present rate of deforestation continues we may losses 90% tropical forest in coming six decades*
3. *For ecological balance 33% area should be under forest cover but our nation has only 20.6% forest cover.*

2. CAUSES OF DEFORESTATION

Forest area in some developed area has expanded. However in developing countries area under forest is showing declining trend particularly in tropical region. Main causes of deforestation are

a) Shifting cultivation or jhum cultivation

This practise is prevalent in tribal areas where forest lands are cleared to grow subsistence crops. It is estimated that principle cause of deforestation in tropics in Africa, Asia and tropical America is estimated to be 70, 50, and 35% respectively. Shifting cultivation which is a practice of slash and burn agriculture are posses to clear more than 5 lakh hectares of land annually. In India, shifting cultivation is prevalent in northeast and to limited extent in M.P, Bihar and Andhra Pradesh and is contributing significantly to deforestation.

b) Commercial logging

It is a important deforestation agent. It may not be the primary cause but definitely it acts as secondary cause, because new logging lots permits shifting cultivation and fuel wood gatherers access to new logged areas.

c) Need for fuel wood

increased population has lead to increasing demand for fuel wood which is also acting as an important deforestation agent, particularly in dry forest.

d) Expansion for agribusiness

With the addition of cash crops such as oil palm, rubber, fruits and ornamental plants, there is stress to expand the area for agribusiness products which results in deforestation.

e) Development projects and growing need for food

The growing demand for electricity, irrigation, construction, mining, etc. has lead to destruction of forest. Increased population needs more food which has compelled for increasing area under agriculture crops compelling for deforestation.

f) Raw materials for industrial use

Forest provides raw material for industry and it has exerted tremendous pressure on forest. Increasing demand for plywood for backing has exerted pressure on cutting of other species such as fir to be used as backing material for apple in J&K and tea in northeast states.

3. MAJOR EFFECTS OF DEFORESTATION

Deforestation adversely and directly affects and damages the environment and living beings Major causes of deforestation are

- *Soil erosion and loss of soil fertility*
- *Decrease of rain fall due to affect of hydrological cycle*
- *Expansion of deserts*
- *Climate change and depletion of water table*
- *Loss of biodiversity ,flora and fauna*
- *Environmental changes and disturbance in forest ecosystems*

4. MINING

Major effects of mining operations on forest and tribal people are:

- *Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining. It leads to degradation of lands and loss of top soil. It is estimated that about eighty thousands hectare land is under stress of mining activities in India*
- *Mining leads to drying up perennial sources of water sources like spring and streams in mountainous area.*
- *Mining and other associated activities remove vegetation along with underlying soil mantle, which results in destruction of topography and landscape in the area. Large scale deforestation has been reported in Mussorie and Dehradun valley due to indiscriminating mining.*
- *The forested area has declined at an average rate of 33% and the increase in non-forest area due to mining activities has resulted in relatively unstable zones leading to landslides.*
- *Indiscriminate mining in forests of Goa since 1961 has destroyed more than 50000 ha of forest land. Coal mining in Jharia, Raniganj and Singrauli areas has caused extensive deforestation in Jharkhand.*
- *Mining of magnetite and soapstone have destroyed 14 ha of forest in hilly slopes of Khirakot, Kosi valley and Almora.*
- *Mining of radioactive minerals in Kerala, Tamilnadu and Karnataka are posing similar threats of deforestation.*
- *The rich forests of Western Ghats are also facing the same threat due to mining projects for excavation of copper, chromites, bauxite and magnetite.*

5. TYPES OF MINING

5.1 Surface mining

Surface mining is done by removing (stripping) surface vegetation, dirt, and, if necessary, layers of bedrock in order to reach buried ore deposits. Techniques of surface mining include:

***Open-pit mining**, which is the recovery of materials from an open pit in the ground, quarrying, identical to open-pit mining except that it refers to sand, stone and clay;*

***Strip mining**, which consists of stripping surface layers off to reveal ore/seams underneath; and mountaintop removal, commonly associated with coal mining, which involves taking the top of a mountain off to reach ore deposits at depth. Most (but not all) placer deposits, because of their shallowly buried nature, are mined by surface methods.*

***Landfill mining** involves sites where landfills are excavated and processed. Landfill mining has been thought of as a solution to dealing with long-term methane emissions and local pollution*

MINING AND DEFORESTATION

Learning Objective

- *Deforestation*
- *Causes of deforestation*
- *Major effects of deforestation*
- *Mining*
- *Types of mining*
- *Effect of mining on environment*
- *Regulation and governance*
- *questions*

1. INTRODUCTION

1. *Forest are burned or cut for clearing of land for agriculture ,harvesting for wood and timber , development and expansion of cities .These economic gains are short term where as long term effects of deforestation are irreversible*
2. *Deforestation rate is relatively low in temperate countries than in tropics If present rate of deforestation continues we may losses 90% tropical forest in coming six decades*
3. *For ecological balance 33% area should be under forest cover but our nation has only 20.6% forest cover.*

2. CAUSES OF DEFORESTATION

Forest area in some developed area has expanded. However in developing countries area under forest is showing declining trend particularly in tropical region. Main causes of deforestation are

a) Shifting cultivation or jhum cultivation

This practise is prevalent in tribal areas where forest lands are cleared to grow subsistence crops. It is estimated that principle cause of deforestation in tropics in Africa, Asia and tropical America is estimated to be 70, 50, and 35% respectively. Shifting cultivation which is a practice of slash and burn agriculture are posses to clear more than 5 lakh hectares of land annually. In India, shifting cultivation is prevalent in northeast and to limited extent in M.P, Bihar and Andhra Pradesh and is contributing significantly to deforestation.

b) Commercial logging

It is a important deforestation agent. It may not be the primary cause but definitely it acts as secondary cause, because new logging lots permits shifting cultivation and fuel wood gatherers access to new logged areas.

5.2 Underground mining

Sub-surface mining consists of digging tunnels or shafts into the earth to reach buried ore *deposits. Ore, for processing, and waste rock, for disposal, are brought to the surface through the tunnels and shafts. Sub-surface mining can be classified by the type of access shafts used, the extraction method or the technique used to reach the mineral deposit. Drift mining utilizes horizontal access tunnels, slope mining uses diagonally sloping access shafts, and shaft mining utilizes vertical access shafts. Mining in hard and soft rock formations require different techniques.*

5.3 Highwall mining

Highwall mining is another form of surface mining that evolved from auger mining. In Highwall mining, the coal seam is penetrated by a continuous miner propelled by a hydraulic Push beam Transfer Mechanism (PTM). A typical cycle includes sumping (launch-pushing forward) and shearing (raising and lowering the cutterhead boom to cut the entire height of the coal seam).

6. EFFECT ON ENVIRONMENT

Environmental issue can include erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to create space for the storage of the created debris and soil. Contamination resulting from leakage of chemicals can also affect the health of the local population if not properly controlled. Extreme examples of pollution from mining activities include coal fires, which can last for years or even decades, producing massive amounts of environmental damage.

7. REGULATION AND GOVERNANCE

New regulations and a process of legislative reforms aim to improve the harmonization and stability of the mining sector in mineral-rich countries.[59] New legislation for mining industry in African countries still appears to be an issue, but has the potential to be solved, when a consensus is reached on the best approach.[60] By the beginning of the 21st century the booming and increasingly complex mining sector in mineral-rich countries was providing only slight benefits to local communities, especially in given the sustainability issues. Increasing debate and influence by NGOs and local communities called for a new approaches which would also include disadvantaged communities, and work towards sustainable development even after mine closure (including transparency and revenue management).

CURRENT ISSUES IN ENVIRONMENT POLLUTION

Learning objectives

- *Introduction*
- *Causes of environment pollution*
- *Effect of environmental pollution.*
- *Solution of environment problem*
- *Environmental ethics*
- *Questions*

1. INTRODUCTION

Pollution is the contamination of the environment by introduction of contaminants that can cause damage to environment and harm or discomfort to humans or other living species. It is the addition of another form of any substance or form of energy to the environment at a rate faster than the environment can accommodate it by dispersion, breakdown, recycling, or storage in some harmless form.

Environmental pollution is one the greatest challenges that the world is facing today. It began since industrial revolution, increasing day by day and causing irreparable damage to Mother Earth. Environmental pollution has its own causes, effects and solutions. Looking into these will help you identify the causes and what steps you can take to mitigate those effects. Broadly, environmental pollution consists of six basic types of pollution, i.e. air, water, land, soil, noise, and light.

2. CAUSES OF ENVIRONMENTAL POLLUTION

- ***Pollution from cars, trucks, and other vehicles*** *is and has been our major environmental pollution issue for almost a century now. The problem is we did not realize this until the problem had manifested to monumental proportions.*

- ***Fossil fuel emissions from power plants*** *which burn coal as fuel contributed heavily, along with vehicles burning fossil fuels, to the production of smog. Smog is the result of fossil fuel combustion combined with sunlight and heat. The result is a toxic gas which now surrounds our once pristine planet. This is known as "ozone smog" and means we have more problems down here than we do in the sky.*

- *Carbon dioxide is another product from all of the vehicles on the planet as well as unreformed power plants and other industrial facilities. A continually growing population of humans and* ***clear cutting of forests*** *has exacerbated this problem so natural defenses are no longer present and carbon dioxide levels are on the rise.*

- ***Water pollution is a major issue****. Many industries dump wastes into rivers, lakes, ponds, and streams in an attempt to hide wastes from EPA inspectors. These water sources feed major crops and food becomes contaminated with a variety of chemicals and bacteria, causing rampant health problems.*

- *Radiation comes into play as well. This is an exceedingly nasty pollution issue and requires extensive description. Primarily, there is radiation from the sun. As the natural* ***ozone layer around the Earth has become depleted****. The sun is wonderful, but the only reason we are able to survive on this planet so close to the sun is due to the fact of natural shielding against solar radiation. As the protective ozone layer around the planet has become thinner, ultraviolet radiation has risen significantly, causing increases in skin cancers and other types of cancer in all countries, killing millions of people every year.*

- *More radiation is a problem. The sun shining brightly on a naked planet is not the only source of radiation we are exposed to.* ***Electromagnetic radiation*** *is another insidious culprit. Once upon a time, the major concern around this type of radiation was due to high tension wires which carry huge amounts of electricity to cities. Now, we even carry sources of this radiation with us as cell phones, laptops, tablets and other wireless devices.*

3. EFFECTS OF ENVIRONMENTAL POLLUTION

- *The polluting gases mentioned above have an interesting* ***effect on climate****. Essentially, these gases form a veil around the planet which holds heat in, increasing the overall temperature of the planet. The rise in planetary temperature, or global warming, is not immediately noticeable. However, even a rise of a few degrees Centigrade causes catastrophic changes in weather. This is happening now.*

- ***Pollen has increased****. It is ironic, but even with fewer trees in the world; the increase of carbon dioxide emissions induces plants such as ragweed and many trees to produce more pollen than ever before. This has resulted in rampant allergies across the world, affecting the health of billions of people.*

- *One of the solutions to tamp out carbon monoxide emissions from coal burning power plants was and still is to use radioactive power plants. While this does cut down on gas emissions significantly, there is* ***radioactive waste*** *which causes various cancers to bloom in major cities and small towns all around while destroying ecosystems entirely.*

- ***Global temperature has risen*** *significantly over the years. The protective atmosphere is further being polluted by methane gas released from melting icecaps. This is causing rampant weather issues around the planet.*

4. SOLUTIONS TO ENVIRONMENTAL POLLUTION

- *Gas emission pollution is being mitigated in a variety of ways with car emission control,* ***electric and hybrid vehicles and public transportation systems****. Not all major cities have successful implementation and decent public transportation in place, but the world is working on this issue constantly and we have managed to reduce emissions profoundly over the last decade. There is much catching up to do.*

- *The cost of radioactive power plants is becoming apparent and the days of coal power plants are nearly dead. The radiation is a serious issue. Radioactive leakage from power plants and nuclear testing have already contaminated oceanic life to such a degree that it will take hundreds of years to return to normal. More radiation solutions are in the works with various* ***ecologically friendly power technologies****being built every day.*

- ***Solar power is a fantastic solution****. Now that solar radiation is at a climactic peak, we can reap power from the sun using solar panel systems. These range from home systems to larger scale systems powering entire communities and cities.*

- ***Wind power is coming into play****. This may not seem like much at first, but when you get about 100 feet off the ground, there is a great deal of wind up there. By building wind turbines to harvest natural wind energy, electricity is produced. Wind turbine power and solar power are both powerful forces against fossil fuel power and radioactive power. The one problem here is power companies. They want to stay with radioactive power plants because they actually can't be removed. It has become the crusades of many individuals and small corporations to make the switch and there are plenty of people following this as populations cry out for help.*

- ***Electromagnetic radiation (ER) reduction****. Once major manufacturers of computers and electronic devices realized the blatant potential for huge ER emissions directly into the eyes and brains of users, they started to implement hardware protocols to minimize risks and reduce ER production significantly. Newer devices are in the lead to knock this problem out and, fortunately, this is working.*

5. ENVIRONMENTAL ETHICS

There are many ethical decisions that human beings make with respect to the environment. For example:

- *Should humans continue to clear cut forests for the sake of human consumption?*
- *Why should humans continue to propagate its species, and life itself?*
- *Should humans continue to make gasoline-powered vehicles?*
- *What environmental obligations do humans need to keep for future generations?*
- *Is it right for humans to knowingly cause the extinction of a species for the convenience of humanity?*
- *How should humans best use and conserve the space environment to secure and expand life?*
- *What role can Planetary Boundaries play in reshaping the human-earth relationship?*

ENVIRONMENTAL LEGISLATION

Learning objectives:

- *Introduction*
- *Environmental law*
- *Function of central board*
- *Function of state board*
- *EIA*
- *Process of EIA*
- *Question*

1. INTRODUCTION

Environmental policies may be either enacted as laws by governing bodies or created and enforced by government agencies. They may originate from local, national or foreign governments, and address an array of issues including (but not limited to) air or water quality, fossil fuel extraction, energy conservation, habitat protection or restoration, pesticide use, storage/disposal of hazardous materials, recycling and trafficking in endangered species.

The quality of the environment has both a direct and an indirect effect on the standard of living. This does not mean that environmental degradation is simply a by-product of economic activities; it is also the consequence of the priorities set by States in their economic policies. These policies generally aim at stimulating production and, as a consequence, tend to ignore their implications for the environment. Past experience, however, shows that economic policies may actually have more impact on the quality of the environment than those policies explicitly designed to protect the environment

2. ENVIRONMENTAL LAW

Academic institutions now offer courses such as environmental laws, environmental studies, environmental management and environmental engineering, that teach the history and methods of environment protection. Waste production, air pollution, and loss of biodiversity (resulting from the introduction of invasive species and species extinction) are some of the issues related to environmental protection. Environmental protection is influenced by three interwoven factors: environmental legislation, ethics and education. Each of this factor plays its part in influencing national-level environmental decisions and personal-level environmental values and behaviours. For environmental protection to become a reality, it is important for societies to develop each of these areas.

2.1 NEED FOR PROTECTION OF ENVIRONMENT

The need for protection of environment can easily be understood from the following facts: = One billion people in the world have no clean water = Two billion people have inadequate facilities of sanitation = One and a half billion people (mostly in large cities of newly industrialized countries) breathe air that is dangerously unhealthy and so on. The human

beings as well as animals need clean food and water, and in order to have clean food and water, it is necessary to protect the ecosystem that makes survival possible. If we do not stop pollution, it is sure that the world will come to an end.

2.2 legal mechanisms in relation to environment protection

'Environmental Law' is an instrument to protect and improve the environment and to control or prevent any act or omission polluting or likely to pollute the environment. An environmental legal system is essentially a set of laws and administrative rules which regulate the relationships and conflicts between all the people concerned with the environment, as well as defining the relationships between people and the environment itself. The Honourable Supreme Court in K. M. Chinnappa v. Union of India defined "Environmental Law" as an instrument to protect and improve the environment and control or prevent any act or omission polluting or likely to pollute the environment. In the Constitution of India, it is clearly stated that it is the duty of the State to "protect and improve the environment and to safeguard the forests and wildlife of the country". It imposes a duty on every citizen "to protect and improve the natural environment including forests, lakes, rivers, and wildlife". Reference to the environment has also been made in the Directive Principles of State Policy (Part IV) as well as the Fundamental Rights (Part III). The Department of Environment was established in India in 1980 to ensure a healthy environment for the country. This later became the Ministry of Environment and Forests in 1985.

2.3 ministries of environment and forests (moef)

The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the Central Government for planning, promotion, coordination and overseeing the implementation of India's environmental and forestry policies and programmes. The primary concerns of the Ministry are implementation of policies and programmes relating to conservation of the country's natural resources including its lakes, rivers, biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. The broad objectives of the Ministry are: = Prevention and control of pollution; = Protection of the environment; and Ensuring the welfare of plants & animals

2.4 The Constitution of India

The 'Right to Life' contained in Article-21 of the Constitution of India includes the right to clean and human environment. It means you have the right to live in a clean and healthy environment.

Article-38 of our Constitution requires State to ensure a social order for the welfare of people, which can be obtained by an unpolluted and clean environment only

Article-48A of the Constitution declares "The State shall endeavour to protect and improve the environment and safeguard forests and wildlife of the country."

Article-51A(g) of the Indian Constitution says: "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures."

2. THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

The Water (Prevention and Control of Pollution) Act was enacted in 1974 to provide for the prevention and control of water pollution, and for maintaining or restoring of wholesomeness of water in the country. This is the first law passed in India whose objective was to ensure that the domestic and industrial pollutants are not discharged into rivers, and lakes without adequate treatment. The reason is that such a discharge renders the water unsuitable as a source of drinking water as well as for the purposes of irrigation and support marine life. In order to achieve its objectives, the Pollution Control Boards at Central and State levels were created to establish and enforce standards for factories discharging pollutants into water bodies.

3. THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

The Air (Prevention and Control of Pollution) Act, 1981 was enacted to provide for the prevention, control and abatement of air pollution in India. It is a specialised piece of legislation which was enacted to take appropriate steps for the preservation of natural resources of the earth, which among other things include the preservation of the quality of air and control of air pollution. The prime objectives of the Act are the following: Prevention, control and abatement of air pollution; z Establishment of central and state pollution control boards to implement the aforesaid purpose; and To maintain the quality of air.

5 THE ENVIRONMENT PROTECTION ACT, 1986

It was the Bhopal Gas Tragedy which necessitated the Government of India to enact a comprehensive environmental legislation, including rules relating to storing, handling and use of hazardous waste. On the basis of these rules, the Indian Parliament enacted the Environment Protection Act, 1986. This is an umbrella legislation that consolidated the provisions of the Water (Prevention and Control of Pollution) Act of 1974 and the Air (Prevention and Control of Pollution) Act of 1981. Within this framework of the legislations, the government established Pollution Control Boards (PCBs) in order to prevent, control, and abate environmental pollution. The objective of the Environment Protection Act is to protect and improve the environment in the country

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

There was no direct provision for 'noise pollution' under the Environment Protection Act, 1986 or any other legislation. The increasing ambient noise levels in public places from various sources like industrial activity, generator sets, loud speakers, vehicular horns etc. have harmful effects on human health. It was the need of the hour to come with a law which would regulate and control noise producing sounds with the objective of maintaining the ambient air quality standards in respect of noise. Therefore, the Central Government framed 'The Noise Pollution (Regulation and Control) Rules, 2000'. These rules have been laid down by the government to reduce environmental noise pollution. Certain standards, such as the ambient air quality standards, have been set by the government. The permissible levels of noise are different for different areas, such as industrial, commercial, residential areas and silence zones (area within the vicinity of hospitals, educational institutions or courts).

7. THE PUBLIC LIABILITY INSURANCE ACT, 1981

This Act aims to provide immediate relief to the persons affected by accident occurring while handling any hazardous substance. It provides that every owner shall take out, before he starts handling any hazardous substance, one or more insurance policies providing for contracts of insurance. The objective of taking insurance is that the compensation resulting from the possible future accident is guaranteed. The collector of the area has been empowered to verify the occurrence of any accident at any place within his jurisdiction and also cause publicity to be given for inviting applications from the victims for any compensation. Apart from the insurance contract, the funding for the purpose of compensation is also generated by the Central Government by the establishment of "Environment Relief Fund." This fund may be utilized by the collector for paying the compensation.

8. THE NATIONAL ENVIRONMENT TRIBUNAL ACT, 1995

This Act is aimed to provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and expendition disposal of cases arising from such accident, with a view to giving relief and compensation for damages to persons, property and the environment and for matters connected with it. The beauty of this Act lies in the fact that the liability of the owner of hazardous substance has been made strict in case of any accident and the resultant injury to public. In any claim for the compensation, the claimant is not required to plead and establish that the death, injury or damage in respect of which the claim has been made was due to any wrongful act, neglect or default of any person. So, the burden of proof does not rest upon the claimant of compensation which is a big relief for the victims.

9. THE NATIONAL ENVIRONMENT APPELLATE AUTHORITY (NEAA) ACT, 1997

The National Environment Appellate Authority (NEAA) was set up by the Ministry of Environment and Forests to address cases in which environment clearance is required in certain restricted areas. It was established by the National Environment Appellate Authority Act 1997 to hear appeals with respect to restriction of areas in which any industries, operations, processes or class of industries, operations or processes shall or shall not be carried out, subject to certain safeguards under the Environment Protection Act, 1986.

10. THE OZONE DEPLETING SUBSTANCES (REGULATION AND CONTROL) RULES, 2000

The Ozone Depleting Substances (Regulation and Control) Rules have been laid down for the regulation of production and consumption of ozone depleting substances. The main objective of this rule is protection of the Ozone layer. The rule restricts unauthorized sale, purchase, import, export and use of ozone depleting substance.

11. FUNCTIONS OF THE CENTRAL BOARD

- *Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.*
- *Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution.*
- *Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement.*
- *Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts.*
- *Lie down or modify (in consultation of the State Governments), the standards for streams or wells and lay down standards for the quality of air.*

12. THE STATE POLLUTION CONTROL BOARDS

The State Governments also have their Pollution Control Boards for example, UPPCB (Uttar Pradesh Pollution Control Board), DPCC (Delhi Pollution Control Board), HPCB (Haryana State Pollution Control Board), RPCB (Rajasthan Pollution Control Board), etc.