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Faculty of Water Supply & Environmental Engineering

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CHAPTER I
POLLUTION SOURCES, CAUSES AND CONTROL

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Chapter I
Pollution Source, Cause and Control

WATER POLLUTION

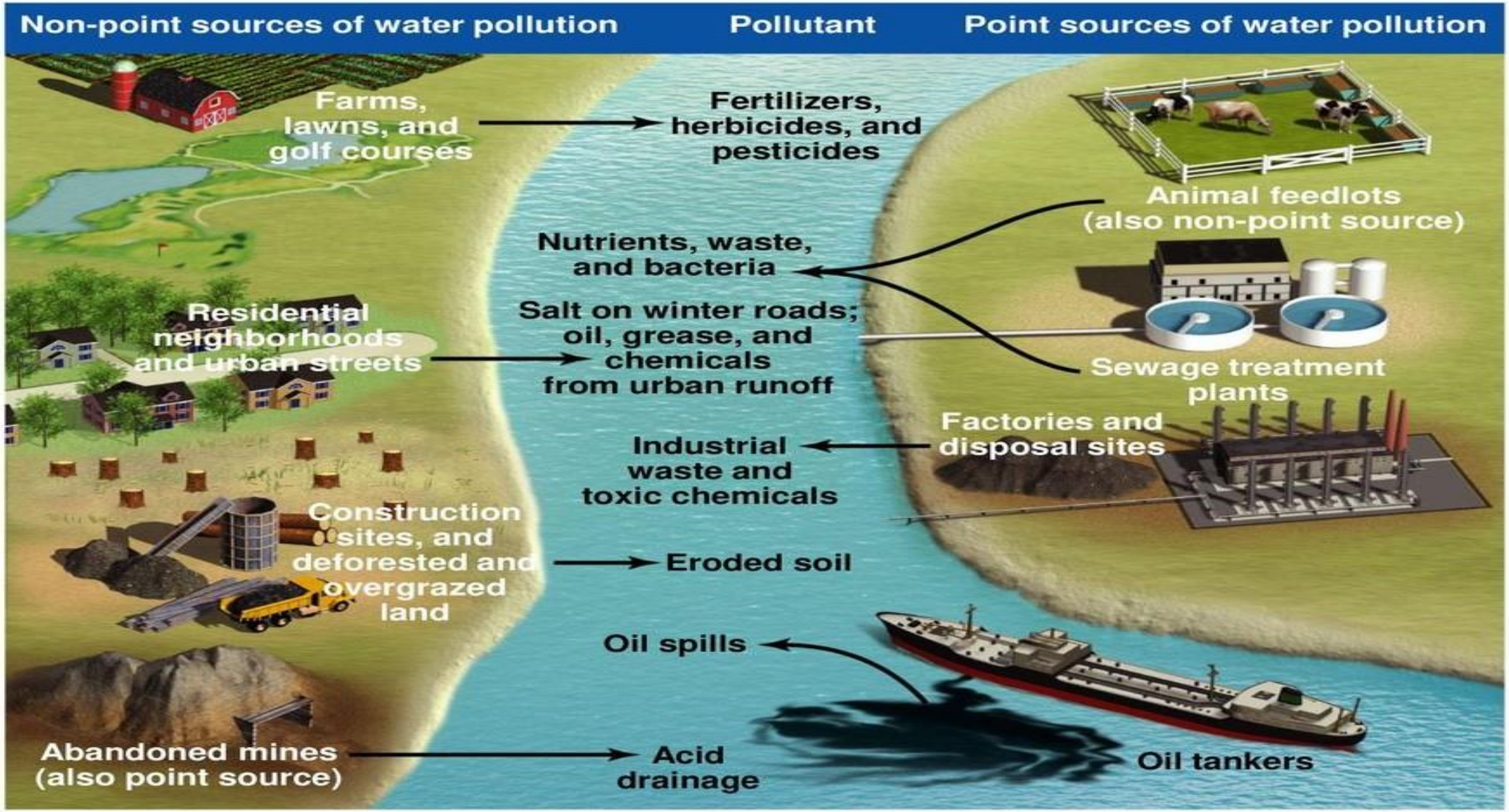
Over two thirds of Earth's surface is covered by water; less than a third is taken up by land. As Earth's population continues to grow, people are putting ever-increasing pressure on the planet's water resources. In a sense, our oceans, rivers, and other inland waters are being "squeezed" by human activities. So their quality is reduced.

1.1 SOURCES OF WATER POLLUTION

The two general categories exist: direct (point sources) and indirect (non-point sources) contaminant sources.

a) Direct sources include effluent outfalls from factories, refineries, waste treatment plants etc, that emit (give out) fluids of varying quality directly into urban water supplies.

b) Indirect sources include contaminants that enter the water supply from soils/groundwater systems and from the atmosphere by rain water. Soils and groundwater contain the residue of human agricultural practices (fertilizers, pesticides, etc.,) and improperly disposed of industrial wastes. Atmospheric contaminants are also derived from human practices (such as gaseous emissions from automobiles, factories and even bakeries).


Non-point sources of water pollution
Pollutant
Point sources of water pollution
Farms, lawns, and golf courses
Fertilizers, herbicides, and pesticides
Animal feedlots (also non-point source)
Nutrients, waste, and bacteria
Residential neighborhoods and urban streets
Salt on winter roads; oil, grease, and chemicals from urban runoff
Sewage treatment plants
Factories and disposal sites
Industrial waste and toxic chemicals
Construction sites, and deforested and overgrazed land
Eroded soil
Oil spills
Oil tankers
Abandoned mines (also point source)
Acid drainage

1.1.2 MAJOR TYPES OF WATER POLLUTION

SEWAGE **-** Sewage pollutants include domestic and hospital wastes, animal and human excreta etc. The sewage let off cause's oxygen depletion, spread of diseases/epidemics.

METALS

Mercury- Metals like mercury are let off into water bodies from industries. Heavy metals like mercury cause poisoning and affect health causing numbness of tongue, lips, limbs, deafness, blurred vision and mental disorders.

Lead - Industrial wastes also lead to lead pollution. If lead enters the human body system in higher quantities it affects RBCs, bone, brain, liver, kidney and the nervous system. Severe lead poisoning can also lead to coma and death.

Cadmium - Source for cadmium pollution is industries, fertilizers. Cadmium gets deposited in visceral organs like liver, pancreas, kidney, intestinal mucosa etc. Cadmium poisoning causes vomiting, headache, bronchial pneumonia, kidney necrosis, etc.

Arsenic - Fertilizers are source for arsenic pollution. Arsenic poisoning causes renal failure & death. It also causes liver and kidney disorders, nervous disorders & muscular atrophy, etc.

AGROCHEMICALS LIKE DDT - It is a pesticide. Accumulation of these pesticides in bodies of fishes, birds, mammals and man affects nervous system, fertility and causes thinning of egg shells in birds.

BACTERIA, VIRUSES AND PARASITES - These are sourced from human and animal excreta, they are infectious agents.

PLASTICS, DETERGENTS, OIL AND GASOLINE - They are a waste from industries, household and farms. They trigger organic pollution and is harmful to health.

INORGANIC CHEMICALS - Inorganic chemicals like acids, salts, metals are a result of industrial effluents, household cleansers, and surface run-off and are injurious to health.

RADIOACTIVE MATERIALS - Mining and ores processing, power plants, weapons production and natural give rise to radioactive pollution like that of uranium, thorium, cesium, iodine and radon. Radioactive pollution causes serious health diseases to all organisms.

PLANT NUTRIENTS - Nutrients like nitrates, phosphates, and ammonium are let off from agricultural and urban fertilizers, sewage and manure. Excess of nutrients cause eutrophication and affect the ecosystem.

SEDIMENTS - Sedimentation of soil, silt due to land erosion and deposition causes disruption in ecosystem.

ANIMAL MANURE AND PLANT RESIDUES - These substances in water causes increased algal blooms and microorganism population. This increases oxygen demand of water, affecting aquatic ecosystem. This is introduced into water due to sewage, agricultural run-off, paper mills, food processing etc.

THERMAL POLLUTION - Temperature changes of water caused due to using water as cooling agent in power plants & industries causes increase in water temperature affect the aquatic life.

1.1.3 CAUSES OF WATER POLLUTION

Industrial waste: Industries produce huge amount of waste which contains toxic chemicals & pollutants which can cause water pollution & damage to us and our environment. They contain pollutants such as lead, mercury, Sulphur, asbestos, nitrates & many other harmful chemicals.

Many industries do not have proper waste management system and drain the waste in the fresh water which goes into rivers, canals & later in to sea. The toxic chemicals have the capability to change the color of water, increase the amount of minerals, also known as Eutrophication, change the temperature of water & pose serious hazard to water organisms.

Sewage and waste water: The sewage and waste water that is produced by each household is to be chemically treated and released in to sea with fresh water. The sewage water carries harmful bacteria and chemicals that can cause serious health problems. Pathogens are known as a common water pollutant; the sewers of cities contain several pathogens and thereby diseases. Microorganisms in water are known to be causes of some very deadly diseases and become the breeding grounds for other creatures that act like carriers. These carriers inflict these diseases by various forms of contact onto an individual. A very common example of this process would be Malaria.

MINING ACTIVITIES: Mining is the process of crushing the rock and extracting coal and other minerals from underground. These elements when extracted in the raw form contain harmful chemicals and can increase the amount of toxic elements when mixed up with water which may result in health problems.

Mining activities emit several metal waste and sulphides from the rocks and is harmful for the water.

ACCIDENTAL OIL LEAKAGE: Oil spill pose a huge concern as large amount of oil enters into the sea and does not dissolve with water; there by opens problem for local marine wildlife such as fish, birds and sea otters. For e.g.: a ship carrying large quantity of oil may spill oil if met with an accident and can cause varying damage to species in the ocean depending on the quantity of oil spill, size of ocean, toxicity of pollutant.

BURNING OF FOSSIL FUELS: Fossil fuels like coal and oil when burnt produce substantial amount of ash in the atmosphere. The particles which contain toxic chemicals when mixed with Water vapour result in acid rain. Also, carbon dioxide is released from burning of fossil fuels which result in global warming.

CHEMICAL FERTILIZERS AND PESTICIDES: Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacteria. They are useful for the plant's growth. Also, when it rains, the chemicals mix up with rainwater and flow down into rivers and canals which pose serious damages for aquatic animals.

LEAKAGE FROM SEWER LINES: A small leakage from the sewer lines can contaminate the underground water and make it unfit for the people to drink. Also, when not repaired on time, the leaking water can come on to the surface and become a breeding ground for insects and mosquitoes.

GLOBAL WARMING: An increase in earth's temperature due to greenhouse effect results in global warming. It increases the water temperature and result in death of aquatic animals and marine species which later results in water pollution.

RADIOACTIVE WASTE: Nuclear energy is produced using nuclear fission or fusion. The element that is used in production of nuclear energy is Uranium which is highly toxic chemical. The nuclear waste that is produced by radioactive material needs to be disposed off to prevent any nuclear accident. Nuclear waste can have serious environmental hazards if not disposed off properly.

1.1.4. CONTROL OF WATER POLLUTION

A) The control of pollution should take place at the point of generation, or, in other words, it should be prevented at source. You should look out for possible sources of pollutants.

B) The control of excess nutrients is an important issue both from a public health perspective and to keep natural waters free from eutrophication.

C) An increasing proportion of water pollution originates from (non-point) sources, such as agricultural use of fertilizer. Farmers may need guidance on good agricultural practices that will help reduce water pollution from agriculture. For example, the amount of fertilizer used and the timing of its application can make a significant difference.

D) Pollution prevention is best achieved by ensuring that each potential point source is properly situated, designed, constructed and managed.

- Sources of pollution should be situated as far as possible away from watercourses (at least 15 m away) and below any water sources on the site.
- Appropriate use of excreta disposal, solid waste disposal and animal waste disposal will help prevent contamination of both surface and groundwater.

- Springs usually become contaminated when latrines, animal yards, sewers, septic tanks, cesspools or other sources of pollution are located on higher land nearby.
- In areas with limestone rocks, contaminated material can enter the water-bearing channels in the rock and descend through cracks and holes or other large openings and may be carried along with groundwater for long distances.

E) For rainwater harvesting,

- pollution control means proper maintenance of the roof and gutters and careful cleaning at the beginning of every wet season.
- Some form of mesh should be placed between the guttering and the pipe that leads to the storage tank to prevent the entry of coarse debris;
- It becomes important to clean the screen regularly to prevent blockage. The worst fouling of roofs occurs when they are situated under trees in which birds roost.
- A rainwater storage tank should be completely covered and well maintained.

F) **The *catchment area*** of the water source is the total area of surrounding land that slopes towards the source. Water can become polluted from sources in the catchment even though they may be some distance away. Ideally, the whole catchment area should be protected to avoid pollution and erosion. Preserving the vegetation in the surrounding area can help protect the spring from pollution and from siltation caused by soil erosion.

What are the key preventive measures that will help to ensure that spring water is of a consistently high quality?

The key measures are:

- Dig a diversion ditch above the spring that will take surface water away from it.
- Build a fence to keep animals away from the spring.
- Design and build a protection box for the spring that will prevent contamination.
- Monitor the condition of the spring and the quality of the water regularly.
- Monitoring of the quality of spring water and other sources would be done by environmental health experts.

1.2 LAND POLLUTION

Land pollution is a major problem around the world and is caused by a variety of factors. Some of main **causes** of soil **pollution** include deforestation and consequent erosion, agriculture, industry, mining, landfills and illegal dumping of waste as well as urbanization and construction.

Land Pollution refers to the deterioration of the earth's land surfaces. Furthermore, it occurs mainly due to the indirect and direct effects of human activities. Similarly, when we misuse the land resources, land pollution happens. The unnecessary materials contaminate the quality of our land. For instance, even the garbage on the streets is a kind of land pollution only.

1.2.1 SOURCES OF LAND POLLUTION

- Oil refineries
- Debris from construction sites
- Littering
- Sewage of human waste
- Agricultural wastes and chemicals
- Industrial toxic waste and chemicals
- Mining
- Demolition
- Nuclear and chemical plants
- Deforestation
- Household wastes
- Landfills that are overflowing
- Antifreeze/oil leaking from cars

1.2.2 TYPES OF LAND POLLUTION

A) Agricultural sources: These include waste matter produced by crop, animal manure, and farm residues. They also include the chemical left over of all pesticides, fertilizers and insecticides used for agricultural activities.

B) Ashes: When waste is burned in incinerators, two types of ashes are produced. Bottom ash is the debris from burnt metal and glass waste. Bottom ash are not bio-degradable. The second type of ash is called fly ash. This is the ash that is trapped by filters in the chimney of the incinerators. It is known to be very toxic (poisonous).

C) Mining sources: This includes piles of coal refuse and heaps of slag and underground debris. Mining and forestry activities that clear the land surfaces often leave the land unrestored. The surface is exposed to erosion which destroys the quality of the land.

D) Industrial sources: These include paints, chemicals, metals and aluminum, plastics and so on that are produced in the process of manufacturing goods.

E) Sewage Treatment: Wastes that are left over after sewage has been treated, biomass sludge, & settled solids. Some of these are sent directly to landfills while other treatment plants burn them to generate electricity. Both end up polluting the environment.

F) Garbage or waste: These include household or municipal waste such as glass, metal, cloth, plastic, wood, paper, and so on. Some of these can decay and others cannot. They are usually collected and sent to landfills where the pollution action begins.

G) Deforestation: This is when trees are cut down for economic purposes, mining, farming and construction. In forests areas, trees absorb and reflect about 20% of the intense heat from the sun, protecting and preserving its surface soils. Cutting down trees mean that the land is exposed to direct sunlight and rain, resulting in soil erosions, desertification and land degradation

H) Construction sources: These include waste like debris, wood, metals and plastics that are produced from construction activities.

I) Chemical and Nuclear Plants: These include chemical waste from chemical industries that are disposed off into landfills.

J) Oil Refineries: When crude oil is refined into usable petro, gas or diesel, there are bye products that end up as waste.

1.2.3 EFFECTS OF LAND POLLUTION

There can be catastrophic consequences of land pollution in relation to humans, animals, water and soils. The effects are even worse if the garbage is not separated into organic, re-usable and recyclable waste.

A) CONTAMINATED LANDS AND ENVIRONMENTS CAN:

- Cause problems in the human respiratory system.
- Cause problems on the skin.
- Cause various kinds of cancers.

B) THE TOXIC MATERIALS THAT POLLUTE THE SOIL CAN GET INTO THE HUMAN BODY DIRECTLY BY:

- Coming into contact with the skin.
- Being washed into water sources like reservoirs and rivers.
- Eating fruits and vegetables that have been grown in polluted soil.
- Breathing in polluted dust or particles.

C) DUMP SITES AND LANDFILLS ALSO COME WITH SERIOUS PROBLEMS LIKE

- Very bad smell and odor in the town.
- Landfills breed rodents like rats, mice and insects, who in-turn transmit diseases.
- Landfills in towns do not attract tourists to the town. The town will loose revenue.
- Many landfills are always burning and they cause further air pollution.

1.2.4 CONTROL OF LAND POLLUTION

- People should be educated and made aware about the harmful effects of littering.

  Discuss with friends and family and talk about it.

- Reuse any items that you can. Items like clothing, bottles, wrapping paper and

  shopping bags can be used over and over again, rather than buying new things.

- The greatest prevention to land pollution is in the three ‘R's’ …

- Reduce Waste,

- Re-use things and
- Recycle things.
- This is true even for governments. They can also use the three ‘R’ rule to minimize the amount of waste that ends up in landfills. After the three 'R's, remember to turn the rest of the garbage into compost.
- Personal litter should be disposed properly. We can separate household waste at home for recycling. More than half of our household waste could be recycled or re-used but once it is mixed up, it becomes more difficult to separate different components for recycling. This is also true for waste we make at school or hospitals.

- Buy biodegradable products.
- Store all liquid chemicals and waste in spill-proof containers.
- Eat organic foods that are grown without pesticides. Look out for fertilizer or pesticide free products when you go to the market.
- Don’t use pesticides if you can.
- Use a drip tray to collect engine oil.
- Buy products that have little packaging.
- Don’t dump motor oil on the ground.

1.3 AIR POLLUTION

The Earth is surrounded by a blanket of air (made up of various gases) called the atmosphere. The atmosphere helps protect the Earth and allow life to exist. Without it, we would be burned by the intense heat of the sun during the day or frozen by the very low temperatures at night.

Air pollution occurs when gases, dust particles, fumes (or smoke) or odour are introduced into the atmosphere in a way that makes it harmful to humans, animals and plant. This is because the air becomes dirty (contaminated or unclean).

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Any additional gas, particles or odors that are introduced into the air (either by nature or human activity) to distort this natural balance and cause harm to living things can be called air pollution.

1.3.1 SOURCE OF AIR POLLUTION

Stationary and Area Sources:

A **stationary source** of air pollution refers to an emission source that does not move, also known as a point source. Stationary sources include factories, power plants, dry cleaners and degreasing operations.

The term **area source** is used to describe many small sources of air pollution located together whose individual emissions may be below thresholds of concern, but whose collective emissions can be significant.

Residential wood burners are a good example of a small source, but when combined with many other small sources, they can contribute to local and regional air pollution levels.

Area sources can also be thought of as non-point sources, such as construction of housing developments, dry lake beds, and landfills.

Mobile Sources: A **mobile source** of air pollution refers to a source that is capable of moving under its own power. In general, mobile sources imply "on-road" transportation, which includes vehicles such as cars, sport utility vehicles, and buses. In addition, there is also a "non-road" or "off-road" category that includes gas-powered lawn tools and mowers, farm and construction equipment, recreational vehicles, boats, planes, and trains.

Agricultural Sources: Agricultural operations, those that raise animals and grow crops, can generate emissions of gases and particulate matter. For example, animals confined to a barn or restricted area (rather than field grazing), produce large amounts of manure. Manure emits various gases, particularly ammonia into the air. This ammonia can be emitted from the animal houses, manure storage areas, or from the land after the manure is applied. In crop production, the misapplication of fertilizers, herbicides, and pesticides can potentially result in aerial drift of these materials and harm may be caused.

Natural Sources: Although industrialization and the use of motor vehicles are overwhelmingly the most significant contributors to air pollution, there are important **natural sources** of "pollution" as well. Wildland fires, dust storms, and volcanic activity also contribute gases and particulates to our atmosphere.

Unlike the above mentioned sources of air pollution, natural "air pollution" is not caused by people or their activities. An erupting volcano emits particulate matter and gases; forest and prairie fires can emit large quantities of "pollutants"; plants and trees naturally emit VOCs which are oxidized and form aerosols that can cause a natural blue haze; and dust storms can create large amounts of particulate matter.

Wild animals in their natural habitat are also considered natural sources of "pollution". The National Park Service recognizes that each of these sources emits gases & particulate matter into the atmosphere but we regard these as constituents resulting from natural processes.

1.3 TYPES OF AIR POLLUTION

PRIMARY POLLUTANTS are those gases or particles that are pumped into the air to make it unclean. They include carbon monoxide from automobile (cars) exhausts and sulfur dioxide from the combustion of coal.

SECONDARY POLLUTANTS: When pollutants in the air mix up in a chemical reaction, they form an even more dangerous chemical. Photochemical smog is an example of this, and is a secondary pollutant.

COMMON AIR POLLUTANTS

CARBON MONOXIDE (CO): **Fuel combustion from vehicles and engines. Reduces the amount of oxygen reaching the body's organs and tissues; aggravates heart disease, resulting in chest pain and other symptoms.**

GROUND-LEVEL OZONE (O3): **Secondary pollutant formed by chemical reaction of volatile organic compounds (VOCs) and NOx in the presence of sunlight.**

Decreases lung function and causes respiratory symptoms, such as coughing and shortness of breath, and also makes asthma and other lung diseases get worse. More on Ground Level Ozone Here

LEAD (PB): Smelters (metal refineries) and other metal industries; combustion of leaded gasoline in piston engine aircraft; waste incinerators (waste burners), and battery manufacturing.

Damages the developing nervous system, resulting in IQ loss and impacts on learning, memory, and behaviour in children. Cardiovascular and renal effects in adults and early effects related to anaemia.

NITROGEN DIOXIDE (NO2): Fuel combustion (electric utilities, big industrial boilers, vehicles) and wood burning. Worsens lung diseases leading to respiratory symptoms, increased susceptibility to respiratory infection.

PARTICULATE MATTER (PM): This is formed through chemical reactions, fuel combustion (e.g., burning coal, wood, diesel), industrial processes, farming (plowing, field burning), and unpaved roads or during road constructions.

Short-term exposures can worsen heart or lung diseases and cause respiratory problems. Long-term exposures can cause heart or lung disease and sometimes premature deaths.

SULFUR DIOXIDE (SO2): SO2 comes from fuel combustion (especially high-sulfur coal); electric utilities and industrial processes as well as natural occurrences like volcanoes.

Aggravates asthma and makes breathing difficult. It also contributes to particle formation with associated health effects.

1.3.3 CAUSE OF AIR POLLUTION

Human activities that result in air pollution include:

1. Emissions from industries and manufacturing activities

Consider a typical manufacturing plant: You will notice that there are long tubes (called chimneys) erected high into the air, with lots of smoke and fumes coming out of it.

Waste incinerators, manufacturing industries and power plants emit high levels of carbon monoxide, organic compounds, and chemicals into the air. This happens almost everywhere that people live. Petroleum refineries also release lots of hydrocarbons into the air.

2. Burning Fossil Fuels

After the industrial age, transportation has become a key part of our lives. Cars and heavy duty trucks, trains, shipping vessels and airplanes all burn lots of fossil fuels to work. Emissions from automobile engines contain both primary and secondary pollutants. This is a major cause of pollution, and one that is very difficult to manage. This is because humans rely heavily on vehicles and engines for transporting people, good and services.

Fumes from car exhaust contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. On their own, they cause great harm to people who breathe them. Additionally, they react with environmental gases to create further toxic gases.

3. Household and Farming Chemicals

Crop dusting, fumigating homes, household cleaning products or painting supplies, insect/pest killers, fertilizer dust emit harmful chemicals into the air and cause pollution. In many cases, when we use these chemicals at home or offices with no or little ventilation, we may fall ill if we breathe them.

1.3.4 EFFECT OF AIR POLLUTION

EUTROPHICATION: Rain can carry and deposit the Nitrogen in some pollutants on rivers and soils. This will adversely affect the nutrients in the soil and water bodies. This can result in algae growth in lakes and water bodies, and make conditions for other living organism harmful.

GROUND-LEVEL OZONE: Chemical reactions involving air pollutants create poisonous gas ozone (O3). Gas Ozone can affect people's health and can damage vegetation types and some animal life too.

PARTICULATE MATTER: Air pollutants can be in the form of particulate matter which can be very harmful to our health. The level of effect usually depends on the length of time of exposure, as well as the kind and concentration of chemicals and particles exposed to Short-term effects include irritation to the eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia. Others include headaches, nausea, and allergic reactions.

Short-term air pollution can aggravate the medical conditions of individuals with asthma and emphysema. Long-term health effects can include chronic respiratory disease, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys. Continual exposure to air pollution affects the lungs of growing children and may aggravate or complicate medical conditions in the elderly.

ACIDIFICATION: Chemical reactions involving air pollutants can create acidic compounds which can cause harm to vegetation and buildings. Sometimes, when an air pollutant, such as sulfur combines with the water droplets that make up clouds, the water droplets become acidic, forming acid rain. When acid rain falls over an area, it can kill trees and harm animals, fish, and other wildlife.

Acid rain destroys the leaves of plants. When acid rain infiltrates into soils, it changes the chemistry of the soil making it unfit for many living things that rely on soil as a habitat or for nutrition. Acid rain also changes the chemistry of the lakes and streams that the rainwater flows into, harming fish and other aquatic life.

1.3.5 AIR POLLUTION PREVENTION, MONITORING AND SOLUTION

GOVERNMENT (OR COMMUNITY) LEVEL PREVENTION: Governments throughout the world have already taken action against air pollution by introducing green energy.

Some governments are investing in wind energy and solar energy, as well as other renewable energy, to minimize burning of fossil fuels, which cause heavy air pollution.

Governments are also forcing companies to be more responsible with their manufacturing activities, so that even though they still cause pollution, they are a lot controlled.

Car manufacturing companies are also building more energy efficient cars, which pollute less than before.

INDIVIDUAL LEVEL PREVENTION: Encourage your family to use the bus, train or bike when commuting. If we all do this, there will be less cars on road and less fumes.

Use energy (light, water, boiler, kettle and fire woods) wisely. This is because lots of fossil fuels are burned to generate electricity, and so if we can cut down the use, we will also cut down the amount of pollution we create.

Recycle and re-use things. This will minimize the dependence of producing new things. Remember manufacturing industries create a lot of pollution, so if we can re-use things like shopping plastic bags, clothing, paper and bottles, it can help.

1.4 MAJOR ENVIRONMENTAL PROBLEMS

The applications of technology (in general) often result in unavoidable environmental impacts for several reasons.

First, the purpose of many technologies is to exploit, control, or otherwise "improve" upon nature for the benefit of humanity. The disturbance of the natural processes by technology is likely to result in negative environmental consequences.

Second, the conservation of mass principle and the first law of thermodynamics (i.e., conservation of energy: energy can be transformed from one form to another, but cannot be created or destroyed) dictate that whenever material resources or energy are moved around or manipulated by technology, environmental consequences are inescapable.

Third, according to the second law of thermodynamics(states that the entropy of any isolated system not in thermal equilibrium always increases.), order can be increased within a system only by increasing disorder or entropy outside the system (i.e., the environment). Thus, technologies can create "order" in the human economy (i.e., order as manifested in buildings, factories, transportation networks, communication systems, etc.) only at the expense of increasing "disorder" in the environment.

1.4.1 THE IMPACT OF AGRICULTURE ON ENVIRONMENT

The environmental impact of agriculture varies based on the wide variety of agricultural practices employed around the world.

Agriculture has been shown to produce significant effects on climate change, through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the Earth's land cover, which can change its ability to absorb or reflect heat and light, thus contributing to radiating force.

Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere.

A wide range of agricultural chemicals (pesticides) are used and some become pollutants through use, misuse, or ignorance.

1.4.1 THE IMPACT OF IRRIGATION ON ENVIRONMENT

Environmental impact of irrigation The environmental impact of irrigation includes the changes in quantity and quality of soil and water as a result of irrigation and effects the natural and social conditions at the downstream side of the irrigation scheme.

An irrigation scheme often draws water from the river and distributes it over the irrigated area. As a hydrological result it is found that:

- ✓ **the downstream river discharge is reduced**
- ✓ **the evaporation in the scheme is increased**

- ✓ the groundwater recharge in the scheme is increased
- ✓ the level of the water table rises
- ✓ the drainage flow is increased. These may be called direct effects. The effects on soil and water quality are indirect and complex, Water logging and soil salinization.

Irrigation can also be done extracting groundwater by (tube) wells. As a hydrological result it is found that the level of the water descends. The effects may be water mining, land/soil subsidence, and, along the coast, saltwater intrusion.

1.4.1 THE IMPACT OF ENERGY INDUSTRY ON ENVIRONMENT

The consumption of fossil fuel resources leads to global warming and climate change.

- **The environmental impact of biodiesel includes greenhouse gas emissions, pollution, biodegradation, biodegradation in aquatic environments, and carbonyl emissions.**
- **The environmental impact of coal mining and burning increase toxic pollution from coal-fired power plants.**

- Electricity generation is significant because modern society uses large amounts of electrical power. This power is normally generated at power plants that convert some other kind of energy into electricity. Each such system has advantages and disadvantages, but many of them pose environmental concerns.
- The environmental impact of petroleum is often negative because it is toxic to almost all forms of life.

- **Nuclear power results from the nuclear fuel cycle processes including mining, processing, transporting and storing fuel and radioactive fuel waste. Released radioisotopes pose a health danger to human populations, animals and plants as radioactive particles enter organisms through various transmission routes.**

1.4.4 THE IMPACT OF MANUFACTURING INDUSTRY ON ENVIRONMENT

CLEANING AGENTS: **are the consequences of chemicals contained in the products that are essential for their *effectiveness.***

LEATHER: **One ton of hide or skin generally leads to the production of 20 to 80 m^3 of wastewater including chromium levels of 100–400mg/L, sulfide levels of 200–800 mg/L and high levels of fat and other solid wastes, as well as notable pathogen contamination.**

PAINT: Traditional painting materials and processes can have harmful effects on the environment, including those from the use of lead and other additives.

PAPER: The environmental impact of paper is significant, which has led to changes in industry and behavior at both business and personal levels. With the use of modern technology such as the printing press and the highly mechanized harvesting of wood, paper has become a cheap commodity. This has led to a high level of consumption and waste.

PESTICIDES: Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including nontarget species, air, water, bottom sediments, and food.

PHARMACEUTICALS AND PERSONAL CARE PRODUCTS: PPCPs have been detected in water bodies throughout the world which lead to various skin diseases and health problems.

1.4.5 EFFECTS ON ENVIRONMENT

BIODIVERSITY: **Human impact on biodiversity is significant, humans have caused the extinction of many species.**

HUMAN IMPACT ON CORAL REEFS **is significant. Coral reefs are dying around the world. In particular, coral mining, pollution (organic and non-organic), overfishing, blast fishing and the digging of canals and access into islands and bays are serious threats to these ecosystems.**

The list of factors is long, including the ocean's role as a carbon dioxide sink, atmospheric changes, ultraviolet light, ocean acidification, biological virus, impacts of dust storms carrying agents to far flung reefs, pollutants, algal blooms and others. Reefs are threatened well beyond coastal areas.

CARBON CYCLE: Global warming is the result of increasing atmospheric carbon dioxide concentrations which is caused primarily by the combustion of fossil energy sources such as petroleum, coal, and natural gas, and to an unknown extent by destruction of forests, increased methane (post-industria1: 150%), volcanic activity and cement production.

Such massive alteration of the global carbon cycle has only been possible because of the availability and deployment of advanced technologies, ranging in application from fossil fuel exploration, extraction, distribution, refining, and combustion in power plants and automobile engines.

Agricultural and industrial nitrogen (N) inputs to the environment currently exceed inputs from natural N fixation. As a consequence of anthropogenic inputs, the global nitrogen cycle

1.4.6 MITIGATION MEASURES

BIRTH CONTROL, also known as contraception and fertility control, are methods or devices used to prevent pregnancy. Planning, provision and use of birth control is called family planning.

CLEANER PRODUCTION is a preventive, company-specific environmental protection initiative. It is intended to minimize waste and emissions and maximize product output.

CLIMATE CHANGE MITIGATION Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases (GHGs).Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation. Mitigation policies can substantially reduce the risks associated with human-induced global warming.

ENVIRONMENTAL MITIGATION, COMPENSATORY MITIGATION, or mitigation banking, are terms used primarily by the United States government and the related environmental industry to describe projects or programs intended to offset known impacts to an existing historic or natural resource such as a stream, wetland, endangered species, archaeological site or historic structure.

To "mitigate" means to make less harsh or hostile. Environmental mitigation is typically a part of an environmental crediting system established by governing bodies which involves allocating debits and credits. Debits occur in situations where a natural resource has been destroyed or severely impaired and credits are given in situations where a natural resource has been deemed to be improved or preserved.

ORGANIC FARMING is a form of agriculture that relies on techniques such as crop rotation, green manure, compost, and biological pest control. Depending on whose definition is used, organic farming uses fertilizers and pesticides (which include herbicides, insecticides and fungicides) if they are considered natural (such as bone meal from animals or pyrethrin from flowers), but it excludes or strictly limits the use of various methods (including synthetic petrochemical fertilizers and pesticides; plant growth regulators such as hormones; antibiotic use in livestock; genetically modified organisms.

CHAPTER II
IMPACTS OF URBANIZATION

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CHAPTER 2: IMPACTS OF URBANIZATION

Urbanization refers to general increase in population and the amount of industrialization of a settlement. It includes increase in the number and extent of cities. It symbolizes the movement of people from rural to urban areas.

2.1 IMPACT OF URBANIZATION ON ENVIRONMENT

2..1.1 IMPACTS ON THE ATMOSPHERE AND CLIMATE

1. **The creation of heat island:** Materials like concrete, asphalt, bricks etc. absorb and reflect energy differently than vegetation and soil. Cities remain warm in the night when the countryside has already cooled.

2. **Changes in Air Quality:** Human activities release a wide range of emissions into the environment including carbon dioxide, carbon monoxide, ozone, sulfur oxides, nitrogen oxides, lead, and many other pollutants.

3. Changes in Patterns of Precipitation: Cities often receive more rain than the surrounding countryside since dust can provoke the condensation of water vapor into rain droplets.

2.1.2 IMPACTS ON THE LITHOSPHERE AND LAND RESOURCES

1. **Erosion and other changes in land quality:** Rapid development can result in very high levels of erosion and reduction in sand quality.

2. **Pollution:** Pollutants are often dispersed across cities or concentrated in industrial areas or waste sites. Lead- based paint used on roads and highways and on buildings is one such example of a widely dispersed pollutant that found its way into soil. Burying tremendous amounts of waste in the ground at municipal and industrial dumps.

2.1.3 IMPACTS ON THE HYDROSPHERE AND WATER RESOURCES

1. **Flow of Water into Streams**: Natural vegetation and undisturbed soil are replaced with concrete, asphalt, brick, and other impermeable surfaces. Therefore when it rains, water is less likely to be absorbed into the ground and, instead, flows directly into river channels.

2. **Flow of Water through Streams:** Higher, faster peak flows change stream channels that have evolved over centuries under natural conditions. Flooding can be a major problem as cities grow and stream channels attempt to keep up with these changes.

3. **Degraded Water Quality**: The water quality has degraded with time due to urbanization that ultimately leads to increased sedimentation there by also increasing the pollutant in run-off.

2.1.4 IMPACTS ON THE BIOSPHERE

1. **MODIFICATION OF HABITATS:** The fertilizers that spread across lawns find its way into water channels where it promotes the growth of plants at the expense of fish. The waste dumped into streams lowers oxygen levels during its decay and cause the die-off of plants and animals.

2. **DESTRUCTION OF HABITATS:** There is complete eradication of habitats as an outcome of urbanization and native species are pushed out of cities.

3. CREATION OF NEW HABITATS: New habitats are also created for some native and non-native species. Cities also create habitats for some species considered pests, such as pigeons, sparrows, rats, mice, flies and mosquitoes. Urbanization has, for example, eliminated many bat colonies in caves, but has provided sites such as bridges for these species to nest.

2.2 Issues of Environment:

2.2.1 Waterborne diseases are caused by pathogenic microorganisms that most commonly are transmitted in contaminated fresh water. Infection commonly results during bathing, washing, drinking, in the preparation of food, or the consumption of food thus infected.

The term "waterborne disease" is reserved largely for infections that predominantly are transmitted through contact with or consumption of infected water.

Microorganisms are very diverse and include all the bacteria and archaea and almost all the protozoa. They also include some members of the fungi, algae, and animals such as rotifers. Many macro animals and plants have juvenile stages which are also microorganisms. Some microbiologists also classify viruses as microorganisms, but others consider these as non-living.

Microorganisms live in every part of the biosphere including soil, hot springs, on the ocean floor, high in the atmosphere and deep inside rocks within the Earth's crust.

Microorganisms are crucial to nutrient recycling in ecosystems as they act as decomposers. As some microorganisms can fix nitrogen, they are a vital part of the nitrogen cycle, and recent studies indicate that airborne microorganisms may play a role in precipitation and weather.

Disease and Transmission	Microbial Agent	Sources of Agent in Water Supply	General Symptoms
Protozoa infections Amoebiasis (hand-to-mouth) amoebic dysentery	Protozoan (*Entamoeba histolytica*) (Cyst-like appearance	Sewage, non-treated drinking water, flies in water supply	Abdominal discomfort, fatigue, weight loss, explosive diarrhea, bloating, fever
Bacterial Diseases Typhoid fever	salmonella typhi	Surface water contaminated by urine or faeces	High fever
Paratyphoid fever	salmonella paratyphi A,B,or C	Contaminated food, specially milk,dried or frozen eggs, dairy products	High Fever, loss of weight
Cholera	Vibrio cholera	Flood waters	Fever ,dehydration
Viruses Polio	Polio myelitis	Contaminated fingers directly or on food	Deformation of bones in children

2.2.2 GREEN HOUSE EFFECT

The action of carbon dioxide and other greenhouse gases in trapping infrared radiation is called the greenhouse effect. The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through a transparent medium & are absorbed, but the longer wavelengths of the infrared re-radiation from the heated objects are unable to pass through that medium. The trapping of the long wavelength radiation leads to more heating and a higher resultant temperature. The carbon dioxide strongly absorbs infrared and does not allow as much of it to escape into space.

Greenhouse Effect Example: Bright sunlight will effectively warm your car on a cold, clear day by the greenhouse effect. The longer infrared wavelengths radiated by sun-warmed objects do not pass readily through the glass. The entrapment of this energy warms the interior of the vehicle. The trapping of the hot air so that it cannot rise and lose the energy by convection also plays a major role. Short wavelengths of visible light are readily transmitted through the transparent windshield.

Contributors to Greenhouse Effect

Those gas molecules in the Earth's atmosphere with three or more atoms are called "greenhouse gases" because they can capture outgoing infrared energy from the Earth, thereby warming the planet. The greenhouse gases include water vapor with three atoms (H_2O), ozone (O_3), carbon dioxide (CO_2), and methane (CH_4). Also, trace quantities of chloro-fluoro-carbons (CFC's) can have a disproportionately large effect.

2.2.3 Ozone layer depletion

Three forms (or allotropes) of oxygen are involved in the ozone-oxygen cycle: oxygen atoms (O or atomic oxygen), oxygen gas (O2 or diatomic oxygen), and ozone gas (O3 or triatomic oxygen). Ozone is formed in the stratosphere when oxygen molecules photodissociate after intaking an ultraviolet photon. This converts a single O2 into two atomic oxygen radicals. The atomic oxygen radicals then combine with separate O2 molecules to create two O3 molecules.

The main source of these halogen atoms in the stratosphere is photodissociation of man-made halocarbon refrigerants, solvents, propellants, and foam-blowing agents (CFCs, HCFCs, freons, halons). These compounds are transported into the stratosphere after being emitted at the surface. Ozone can be destroyed by a number of free radical catalysts, the most important of which are the hydroxyl radical (OH^-), the nitric oxide radical (NO^-), atomic chlorine ion ($Cl\cdot$) and atomic bromine ion ($Br\cdot$).

CFCs AND RELATED COMPOUNDS IN THE ATMOSPHERE

Chlorofluorocarbons (CFCs) and other halogenated ozone depleting substances (ODS) are mainly responsible for man-made chemical ozone depletion.

CFCs were invented by Thomas Midgley Jr. in the 1920s. They were used in air conditioning and cooling units, as aerosol spray propellants prior to the 1970s, and in the cleaning processes of delicate electronic equipment. They also occur as by-products of some chemical processes. No significant natural sources have ever been identified for these compounds—their presence in the atmosphere is due almost entirely to human manufacture.

CONSEQUENCES OF OZONE LAYER DEPLETION

Since the ozone layer absorbs UVB ultraviolet light from the sun, ozone layer depletion is expected to increase surface UVB levels, which could lead to damage, including increase in skin cancer.

BIOLOGICAL EFFECTS: The main public concern regarding the ozone hole has been the effects of increased surface UV radiation on human health. Environmentalists have been concerned that the increase in surface UV could be significant. UVB (the higher energy UV radiation absorbed by ozone) contributes to skin cancer and to produce Vitamin D.

INCREASED TROPOSPHERIC OZONE: Increased surface UV leads to increased tropospheric ozone. Ground-level ozone is generally recognized to be a health risk, as ozone is toxic due to its strong oxidant properties. The risks are particularly high for young children, the elderly, and those with asthma or other respiratory difficulties.

INCREASED PRODUCTION OF VITAMIN D: Vitamin D is produced in the skin by ultraviolet light. Thus, higher UV-B exposure raises human vitamin D in those deficient in it. Blood level of Vitamin D in excess of 100 ng/ml appear to raise blood calcium excessively and to be associated with higher mortality, the body has mechanisms that prevent sunlight from producing Vitamin D in excess of the body's requirements.

CORTICAL CATARACTS: Studies are suggestive of a cortical cataracts

EFFECTS ON NON-HUMAN ANIMALS: A November 2010 report by scientists at the Institute of Zoology in London found that whales off the coast of California have shown a sharp rise in sun damage, and these scientists "fear that the thinning ozone layer is to blame".

EFFECTS ON CROPS: An increase of UV radiation would be expected to affect crops. A number of economically important species of plants, such as rice, depend on cyanobacteria residing on their roots for the retention of nitrogen. Cyanobacteria are sensitive to UV radiation and would be affected by its increase.

2.2.4 Acid Rains

"Acid rain" is a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulfuric acids.,

- The principal cause of acid rain is sulfur and nitrogen compounds from human sources, such as electricity generation, factories, and motor vehicles. Electrical power complexes utilizing coal are among the greatest contributors to gaseous pollutions that are responsible for acidic rain.

- Acid rain forms from both natural sources, such as volcanoes and decaying vegetation, and man-made sources such as emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) resulting from fossil fuel combustion.
- Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. The result is a mild solution of sulfuric acid and nitric acid. When sulfur dioxide and nitrogen oxides are released from power plants and other sources.

- The most important gas which leads to acidification is **sulfur dioxide**. Emissions of nitrogen oxides which are oxidized to form nitric acid are of increasing importance due to stricter controls on emissions of sulfur containing compounds. The principal natural phenomena that contribute acid-producing gases to the atmosphere are emissions from volcanoes.

Gas phase chemistry

In the gas phase sulfur dioxide is oxidized by reaction with the hydroxyl radical via an intermolecular reaction:

$SO_2 + OH^- \rightarrow HOSO_2^-$ which is followed by:

$HOSO_2^- + O_2 \rightarrow HO_2^- + SO_3$

In the presence of water, sulfur trioxide (SO_3) is converted rapidly to sulfuric acid:

$SO_3\ (g) + H_2O\ (l) \rightarrow H_2SO_4\ (aq)$

Nitrogen dioxide reacts with OH to form nitric acid:

$NO_2 + OH\cdot \rightarrow HNO_3$

ADVERSE EFFECTS

Acid rain has been shown to have adverse impacts on forests, freshwaters and soils, killing insect and aquatic life-forms as well as causing damage to buildings and having impacts on human health.

SURFACE WATERS AND AQUATIC ANIMALS: Both the lower pH and higher aluminium concentrations in surface water that occur as a result of acid rain can cause damage to fish and other aquatic animals. At pH lower than 5 most fish eggs will not hatch and lower pH can kill adult fish. As lakes and rivers become more acidic biodiversity is reduced.

HUMAN HEALTH EFFECTS: Acid rain does not directly affect human health. The acid in the rainwater is too dilute to have direct adverse effects. However, the particulates responsible for acid rain (sulfur dioxide and nitrogen oxides) do have an adverse effect. Increased amounts of fine particulate matter in the air do contribute to heart and lung problems including asthma and bronchitis.

SOILS: Soil biology and chemistry can be seriously damaged by acid rain. Some microbes are unable to tolerate changes to low pH and are killed.

FORESTS AND OTHER VEGETATION: Adverse effects may be indirectly related to acid rain, like the acid's effects on soil (see above) or high concentration of gaseous precursors to acid rain. High altitude forests are especially vulnerable as they are often surrounded by clouds and fog which are more acidic than rain.

EFFECT OF ACID RAIN ON STATUES: Acid rain can damage buildings, historic monuments, and statues, especially those made of rocks, such as limestone and marble, that contain large amounts of calcium carbonate. Acids in the rain react with the calcium compounds in the stones to create gypsum, which then flakes off.

CHAPTER III
SOLID WASTE MANAGEMENT

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CHAPTER III
SOLID WASTE MANAGEMENT

3.1 SOLID WASTE

3.2 SOLID WASTE MANAGEMENT

3.3 CLASSIFICATION OF SOLID WASTES

3.4 WASTE GENERATION, COLLECTION, TRANSFER AND TRANSPORT

3.5 METHODS OF SOLID WASTE TREATMENT

1. COMPOSTING
2. LANDFILLS
3. INCINERATION

3.6 HAZARDOUS WASTE (HANDLING)

1. TRANSPORT OF HAZARDOUS WASTE
2. TREATMENT, STORAGE, AND DISPOSAL
3. REMEDIAL ACTION

SOLID WASTE

All wastes arising from human and animal activities that are normally solid and are discarded as useless or unwanted. Discarded waste material are often reusable.

SOLID WASTE MANAGEMENT

A term applicable to all activities associated with the management of the solid waste in a manner that meets public health and environmental concerns and public desire to reuse and recycle waste material.

The **objective of solid waste management** is to reduce the quantity of solid waste disposed off on land by recovery of materials and energy from solid waste.

CLASSIFICATION OF SOLID WASTES

(i) Domestic/Residential Waste: This waste comprises the solid wastes that come from single and multi-family household units. These come from household activities such as cooking, cleaning, repairs, hobbies, decoration, empty containers, packaging, clothing, old books, writing/new paper, and old furnishings. Households also discard bulky wastes such as furniture and large appliances which cannot be repaired and used.

(II) MUNICIPAL WASTE: Municipal waste includes wastes resulting from municipal activities and services such as street waste, dead animals, market waste and abandoned vehicles.

(III) COMMERCIAL WASTE: These are solid wastes that originate in offices, wholesale and retail stores, restaurants, hotels, markets, warehouses and other commercial establishments.

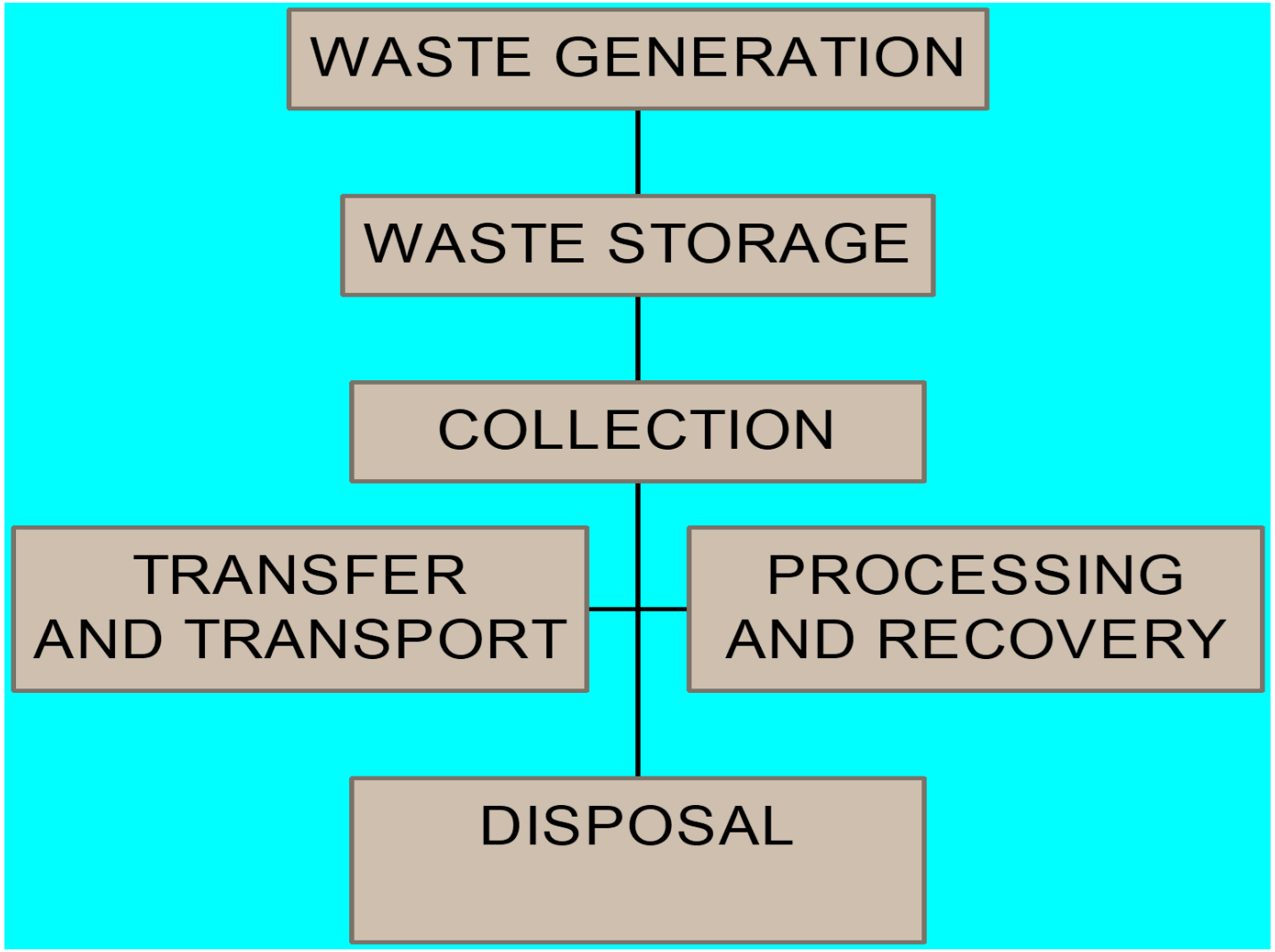
(IV) INSTITUTIONAL WASTE: Institutional wastes are those arising from institutions such as schools, universities, hospitals and research institutes. It includes wastes which are Classified as garbage and rubbish as well as wastes which are considered to be hazardous to public health and to the environment.

(V) CONSTRUCTION AND DEMOLITION WASTES: Construction and demolition wastes are the waste materials generated by the construction, refurbishment, repair and demolition of houses, commercial buildings and other structures. It mainly consists of earth, stones, concrete, bricks, lumber, roofing materials, plumbing materials, heating systems and electrical wires and parts of the general municipal waste stream.

(VI) INDUSTRIAL WASTES: In the category is the discarded solid material of manufacturing processes and industrial operations. They cover a vast range of substances which are unique to each industry. For this reason they are considered separately from municipal wastes.

(vii) Hazardous Wastes: Hazardous wastes may be defined as wastes of industrial, institutional or consumer origin which, because of their physical, chemical or biological characteristics are potentially dangerous to human and the environment.

FUNCTIONAL ELEMENTS OF SOLID WASTE



FUNCTIONAL ELEMENTS OF SOLID WASTE

WASTE GENERATION: Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal.

WASTE HANDLING, SORTING, STORAGE, AND PROCESSING AT THE SOURCE: Waste handling and Sorting involves the activities associated with management of wastes until they are placed in storage containers for collection. **Sorting** of waste components is to separate waste materials for reuse and recycling is at the source of generation.

PROCESSING At the source involves activities such as backyard waste composting.

COLLECTION: The functional element of collection includes not only the gathering of solid wastes and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied.

TRANSFER AND TRANSPORT: The functional element of transfer and transport involves two steps: (i) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (ii) the subsequent transport of the wastes, usually over long distances, to a processing or disposal site. The transfer usually takes place at a transfer station.

DISPOSAL: A municipal solid waste landfill plant is an engineered facility used for disposing of solid wastes on land or within the earth's mantle without creating nuisance or hazard to public health or safety, such as breeding of rodents and insects and contamination of groundwater.

METHODS OF SOLID WASTE TREATMENT

The organic content of Municipal Solid Waste (MSW) tends to decompose leading to various smell and odour problems. It also leads to pollution of the environment. To ensure a safe disposal of the MSW it is desirable to reduce its pollution potential and several processing methods are proposed for this purpose.

1. COMPOSTING: Composting process is quite commonly used and results in production of a stable product called “compost” which depending upon its quality can be used as a low-grade manure and soil conditioner.

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing compost manure by adopting this natural phenomenon. Compost is particularly useful as organic manure which contains plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients which can be utilized for the growth of plants.

Composting can be carried out in two ways i.e., aerobically and anaerobically. During aerobic composting aerobic micro-organisms oxidize organic compounds to Carbon di-oxide, Nitrite and Nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to exothermic reaction, temperature of the mass rises.

During anaerobic process, the anaerobic microorganisms, while metabolizing the nutrients, break down the organic compounds through a process of reduction. A very small amount of energy is released during the process & the temperature of composting mass does not raise much. The gases evolved are mainly Methane and Carbon dioxide.

An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land.

Mechanism of Composting

Composting is a biochemical process in which aerobic and anaerobic microorganism decomposes organic matter into valuable manure called as compost.

Release heat

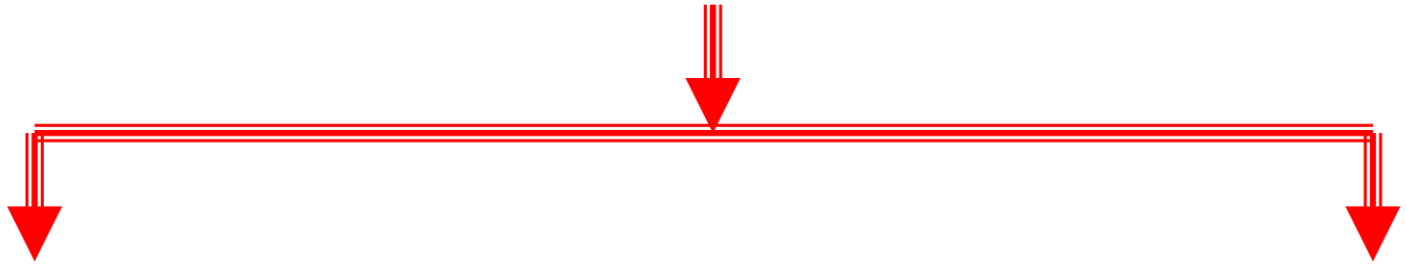
(Thermophilic state, which helps to destroy pathogens)

Organic matter → (Temp 55-60° c) **Organic matter** → **compost**

(Mesophilic state ,Temp. 25-30o c, promote mesophilic microbes for rapid decomposition)

Microorganism Involved in Composting

Two type of microbes which help in composting process are:



Aerobes

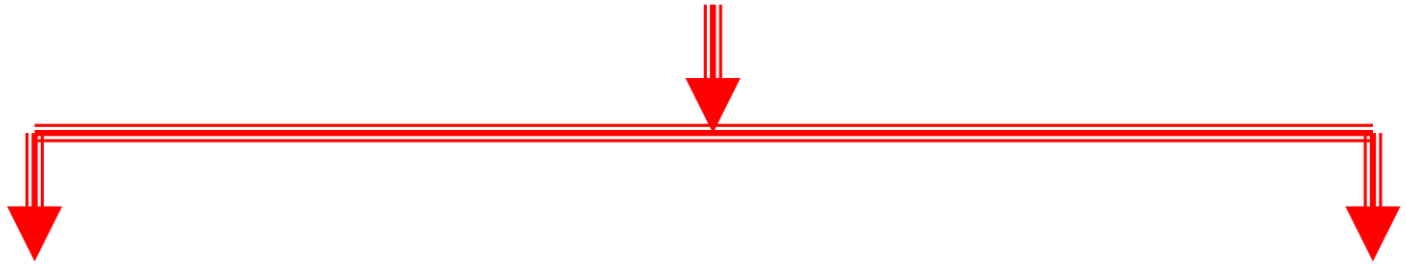
Which decompose organic matter in presence of oxygen

Anaerobes

Which decompose organic matter in absence of oxygen

Microorganism Involved in Composting

Two type of microbes which help in composting process are:



Aerobes

Which decompose organic matter in presence of oxygen

Anaerobes

Which decompose organic matter in absence of oxygen

Indore Method

- In the Indore method of composting, organic wastes are spread in the cattle shed to serve as bedding.
- Urine soaked material along with dung is removed every day and formed into a layer of about 15 cm thick at suitable sites.
- Urine soaked earth, scraped from cattle sheds is mixed with water and sprinkled over the layer of wastes twice or thrice a day.

- Layering process continued for about a fortnight. A thin layer of well decomposed compost is sprinkled over top and the heap given a turning and reformed.
- Old compost acts as inoculum for decomposing the material.
- The heap is left undisturbed for about a month. Then it is thoroughly moistened and given a turning. The compost is ready for application in another month.

Size of the Pit

Breadth - 6-8 feet

Depth - 2-3 feet (not more than 3 feet)

Length - 10 feet or more as per requirement

Raw Material

Mix plant residues, weeds, sugarcane leaves, grass, wood ashes, bran etc.

Animal dung

Urine soaked mud

Wood ashes

Water

Filling The Compost Pit

1. First of all, spread dry wastes with cattle dung and soil in ratio of 4:2:1 up to 2 inch layer in Composting pit.
2. Afterwards, sprinkle the water over the materials.
3. Pit is filled with above materials up to 1 foot above the ground level
4. One more layer of bedding material with wood ash and urinated mud should be added.

Turning of the Martial in Pit

The material is turned three times for proper aeration and moisture.

First turning :

10-15 days after filling the pits.

Second turning :

15 days after first turning.

Third turning :

After 2 month of second turning

Bangalore Method

- In the Bangalore method of composting, dry waste material of 25 cm thick is spread in a pit and a thick suspension of cow dung in water is sprinkled over for moistening.
- A thin layer of dry waste is laid over the moistened layer.
- The pit is filled alternately with dry layers of material and cow dung suspension till it rises 0.5 m above ground level.
- It is left exposed without covering for 15 days. It is given a turning, plastered with wet mud and left undisturbed for about 5 months or till required.

This method saves labour cost because there is no need of turning and regular sprinkling of water.

Size of the pit

Composting is done in trenches of 30’ × 6’ × 3’ or in pits of 20’ × 6’ ×3.

Method of Filling The Compost Pit

- Spread the moist farm refuse at the bottom of the pit up to one inch.
- Then, spread two inch of cattle dung and urinated mud followed by 1 or 2 inch layer of soil.
- This heap is made up to 1.5-2.0 feet above the ground level following above process.
- Finally the heap is covered with 1inch thick mud.

After 8-9 months all material decomposes and compost becomes ready for the application.

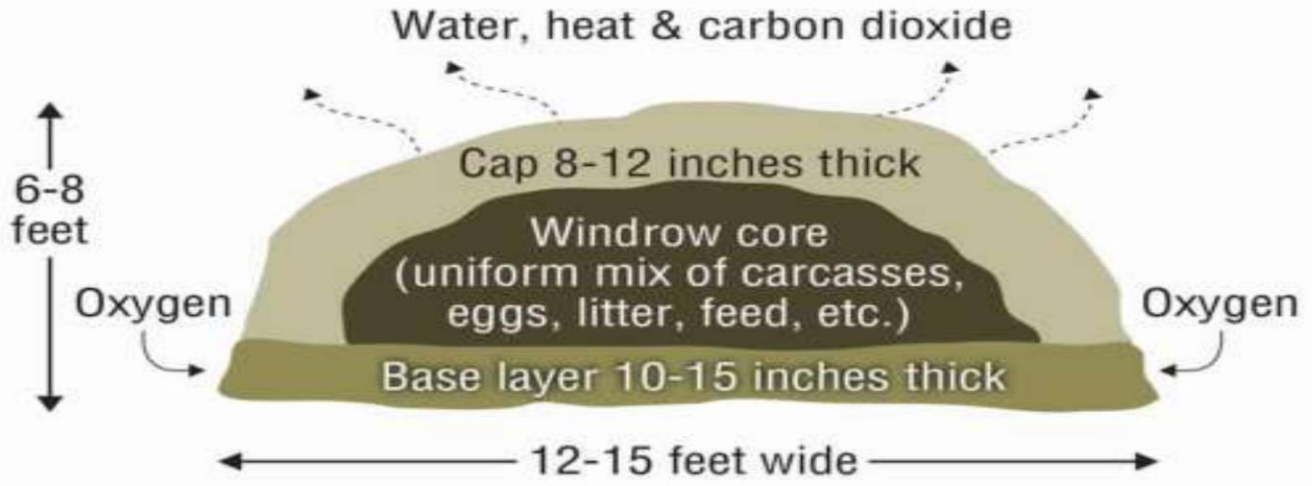
Windrow Composting

A. Turned windrow

- Here the materials are placed in long narrow piles/windrow which are agitated on a regular basis.
- Enhances the passive aeration.
- The rate of air exchange depends on porosity of windrow.
- Turnings can be accomplished with a front end loader or a bucket loader on a tractor.
- Schedule of turning is single turning per week,were the frequency of turning decreases as the windrow ages.
- A common period for manure composting operation is about 8 weeks.

Size of the Pit

Figure 1. Cross section of windrow



PASSIVE AERATED WINDROWS

- It eliminates the need of turning by suppling the air through perforated pipes .
- The windrow should be 90-120cm height.
- The pipe holes are oriented downwards to minimize the plugging.
- The aeration pipes are placed on the top of the peat/compost base.
- Seafood waste with peat moss, manure slurries with peat moss and solid manure with straw or wood shavings, manure from dairy , beef, swine and sheep has also been used.

Aerated static pile

- Here pipe aeration system and blowers are used to supply the air.
- No turnings of the material occur once the pile is formed.
- The activated composting period is completed in about 3-5weeks.
- The initial height of the piles is about 150-245cm high.
- The raw material mixture is pile over a base of woodchips, chopped straw or other very porous material
- The porous base material contains a perforated aeration pipe. the pipe is connected to a blower, which either pull or pushes air through the pile.
- The pile is top off by 15cm of finished compost.

Off-smell management in composting

- Ensure that your compost pile is properly aerated
- Adjust the ratio of nitrogen rich and carbon rich material in your compost pile.
- Keep your compost pile free of meat and dairy.

LAND FILLS

The term ‘landfill’ is used herein to describe a unit operation for final disposal of ‘Municipal Solid Waste’ on land, designed and constructed with the objective of minimum impact to the environment.

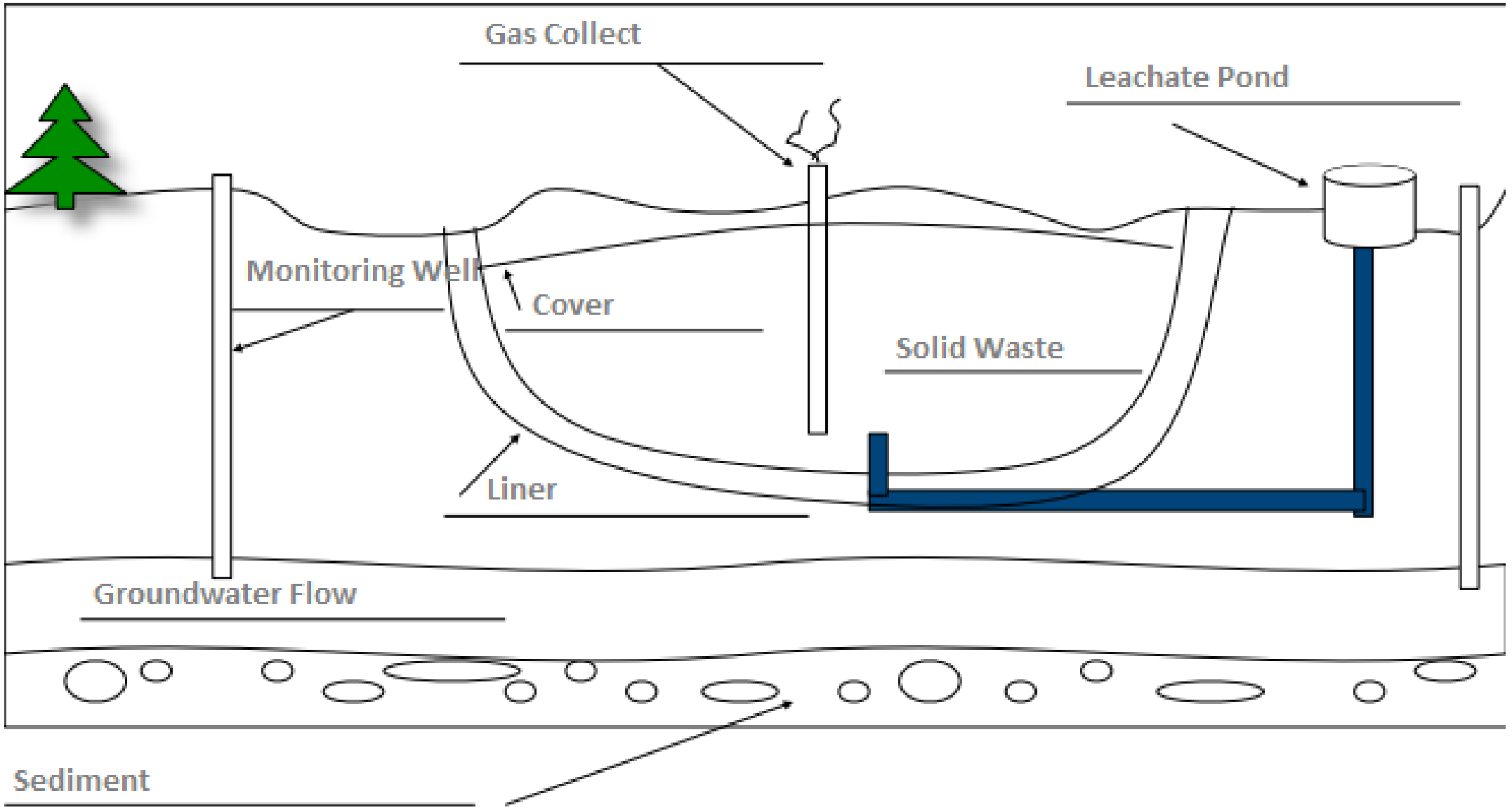
There are two ways to bury trash:

Dump - an open hole in the ground where trash is buried and that has various animals (rats, mice, birds) swarming around.

Landfill - carefully designed structure built into or on top of the ground in which trash is isolated from the surrounding environment (groundwater, air, rain). This isolation is accomplished with a bottom liner and daily covering of soil.

- ✓ *A **sanitary landfill** uses a clay liner to isolate the trash from the environment.*
- ✓ *A **municipal solid waste (MSW) landfill** uses a synthetic (plastic) liner to isolate the trash from the environment.*

Parts of a Land Fill



PARTS OF A LAND FILL

BOTTOM LINER SYSTEM - separates trash and subsequent leachate from groundwater

CELLS – are those where the trash is stored within the landfill

STORM WATER DRAINAGE SYSTEM – It collects rain water that falls on the landfill

LEACHATE COLLECTION SYSTEM – It collects water that has percolated through the landfill itself and contains contaminating substances (**leachate**)

METHANE COLLECTION SYSTEM – It collects methane gas that is formed during the breakdown of trash

COVERING OR CAP - seals off the top of the landfill.

TYPES OF LANDFILLS

SANITARY LANDFILLS - landfill that uses a clay liner to isolate the trash from the environment.

MUNICIPAL SOLID WASTE (MSW) LANDFILLS - uses a synthetic (plastic) liner to isolate the trash from the environment.

CONSTRUCTION AND DEMOLITION WASTE LANDFILLS - consist of the debris generated during the construction, renovation, and demolition of buildings, roads, and bridges.

INDUSTRIAL WASTE LANDFILLS- consists of non-hazardous waste associated with manufacturing and other industrial activities

3. INCINERATION

It is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration of waste materials converts the waste into ash, flue gas, and heat. The ash is mostly formed by the inorganic constituents of the waste, and may take the form of solid lumps or particulates carried by the flue gas. In some cases, the heat generated by incineration can be used to generate electric power.

Incineration with energy recovery is one of several waste-to-energy (WtE) technologies such as gasification, pyrolysis and anaerobic digestion.

Incinerators reduce the solid mass of the original waste by 80–85% and the volume (already compressed somewhat in garbage trucks) by 95–96%, depending on composition

The collection, treatment, and disposal of hazardous waste material when not properly handled, can cause substantial harm to human health and safety or to the environment. Hazardous wastes can take the form of solids, liquids, sludges, or contained gases, and they are generated primarily by chemical production, manufacturing, and other industrial activities. They may cause damage during inadequate storage, transportation, treatment, or disposal operations. Improper hazardous-waste storage or disposal frequently contaminates surface and groundwater supplies.

HAZARDOUS WASTE CHARACTERISTICS

Hazardous wastes are classified on the basis of their physical, chemical, and biological properties. These properties generate materials that are toxic, reactive, ignitable, corrosive, infectious, or radioactive.

Toxic wastes are poisonous, even in very small or trace amounts. They may have acute effects, causing death or violent illness. Some are carcinogenic, causing cancer after many years of exposure. Others are mutagenic (changes in the body tissues and structure), causing major biological changes in the offspring of exposed humans and wildlife.

TYPES OF HAZARDOUS WASTE

Reactive wastes are chemically unstable and react violently with air or water. They cause explosions or form toxic vapors.

Ignitable wastes burn at relatively low temperatures and may cause an immediate fire hazard.

Corrosive wastes include strong acidic or alkaline substances. They destroy solid material and living tissue upon contact, by chemical reaction.

Infectious wastes include used bandages, hypodermic needles, and other materials from hospitals or biological research facilities.

Radioactive wastes emit ionizing energy that can harm living organisms. Because some radioactive materials can persist in the environment for many thousands of years before fully decaying, there is much concern over the control of these wastes.

Hazardous waste generated at a particular site often requires transport to an approved **treatment, storage, or disposal facility** (TSDF). Because of potential threats to public safety and the environment, transport is given special attention by governmental agencies.

In addition to the occasional accidental spill, hazardous waste has, in the past, been intentionally spilled or abandoned at random locations in a practice known as **"midnight dumping."** This practice has been greatly curtailed by the enactment of laws that require proper labeling, transport, and tracking of all hazardous wastes.

TREATMENT, STORAGE, AND DISPOSAL

Several options are available for hazardous-waste management. The most desirable is to reduce the quantity of waste at its source or to recycle the materials for some other productive use. Nevertheless, while reduction and recycling are desirable options, they are not regarded as the final remedy to the problem of hazardous-waste disposal. There will always be a need for treatment and for storage or disposal of some amount of hazardous waste.

TREATMENT

Hazardous waste can be treated by chemical, thermal, biological, and physical methods.

PHYSICAL TREATMENT, on the other hand, concentrates, solidifies, or reduces the volume of the waste. Physical processes include evaporation, sedimentation, flotation, and filtration.

CHEMICAL METHODS include ion exchange, precipitation, oxidation and reduction, and neutralization.

BIOLOGICAL TREATMENT of certain organic wastes, such as those from the petroleum industry, is also an option. One method used to treat hazardous waste biologically is called land farming. In this technique the waste is carefully mixed with surface soil on a suitable tract of land. Microbes that can metabolize the waste may be added, along with nutrients. In some cases a genetically engineered species of bacteria is used.

THERMAL METHODS are high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.

Aerated static pile

- Here pipe aeration system and blowers are used to supply the air.
- No turnings of the material occur once the pile is formed.
- The activated composting period is completed in about 3-5weeks.
- The initial height of the piles is about 150-245cm high.
- The raw material mixture is pile over a base of woodchips, chopped straw or other very porous material
- The porous base material contains a perforated aeration pipe. the pipe is connected to a blower, which either pull or pushes air through the pile.
- The pile is top off by 15cm of finished compost.

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Hazardous wastes that are not destroyed by incineration or other chemical processes need to be disposed of properly. For most such wastes, land disposal is the ultimate destination, although it is not an attractive practice, because of the inherent environmental risks involved.

Two basic methods of land disposal include landfilling and underground injection. Temporary on-site waste storage facilities include open waste piles and ponds or lagoons. The piles must be protected from wind dispersion or erosion. If leachate is generated, monitoring and control systems must be provided.

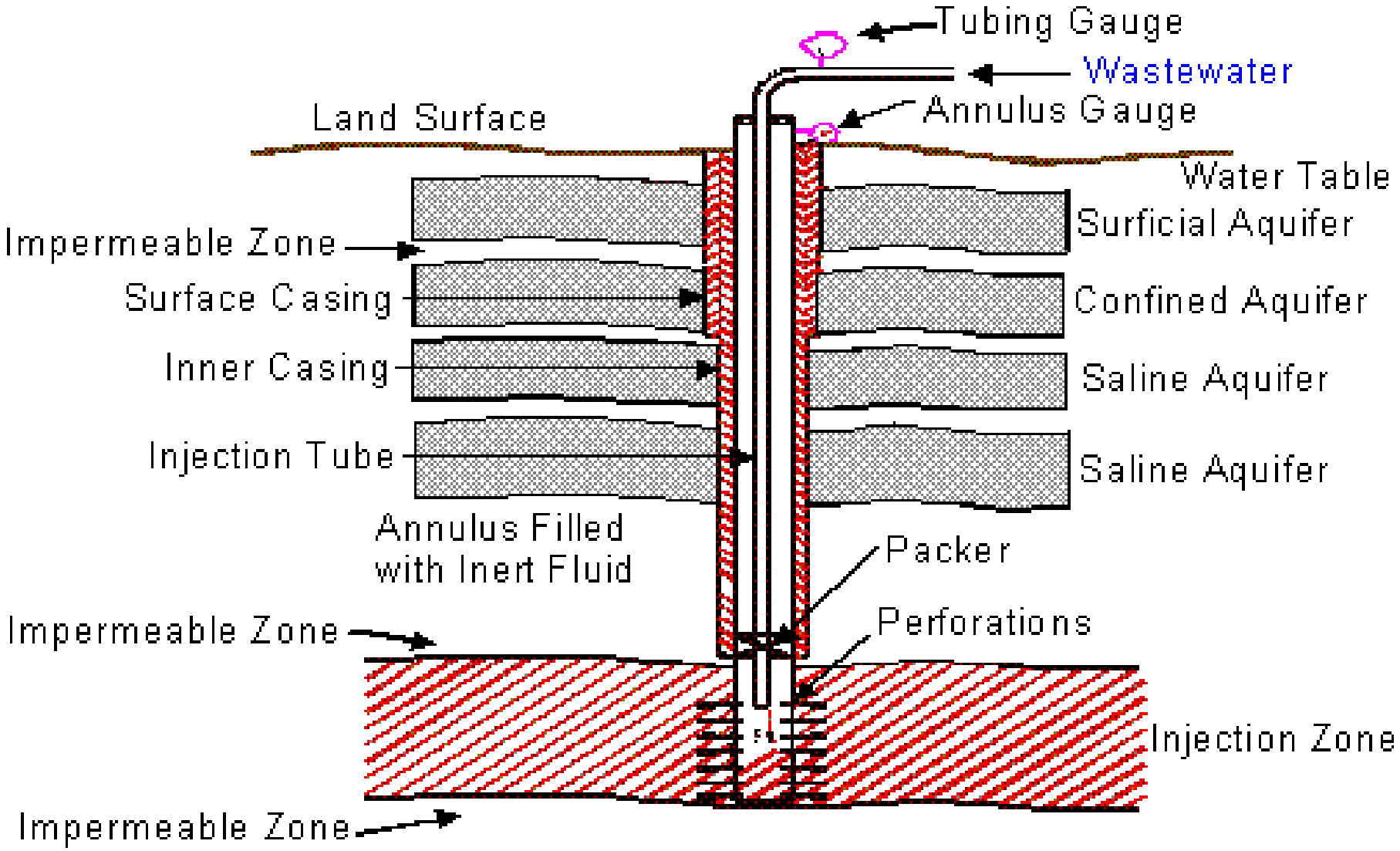
Landfilling of hazardous solid or containerized waste is regulated more stringently than landfilling of municipal solid waste. Hazardous wastes must be deposited in so-called secure landfills, which provide at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table. A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems.

Deep Well Injection: One of the option for the disposal of liquid hazardous waste is **deep-**

DEEP-WELL INJECTION

One of the option for the disposal of liquid hazardous waste is **deep-well injection**, a procedure that involves pumping liquid waste through a steel casing into a porous layer of limestone or sandstone. High pressures are applied to force the liquid into the pores and fissures of the rock, where it is to be permanently stored. The injection zone must lie below a layer of impervious rock or clay, and it may extend more than 0.8 km (0.5 mile) below the surface. Deep-well injection is relatively inexpensive and requires little or no pretreatment of the waste, but it poses a danger of leaking hazardous waste and eventually polluting subsurface water supplies.

DEEP-WELL INJECTION



REMEDIAL ACTION

Disposal of hazardous waste in unlined pits, ponds, or lagoons poses a threat to human health and environmental quality. Many such uncontrolled disposal sites were used in the past and have been abandoned. Depending on a determination of the level of risk, it may be necessary to remediate those sites.

One option for remediation is to completely remove all the waste material from the site and transport it to another location for treatment and proper disposal.

SURFACE STORAGE AND LAND DISPOSAL

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CHAPTER IV
ENVIRONMENTAL IMPACT ASSESSMENT

Dr Bhupender Singh Sandher, Faculty of WSEE, AWIT, AMU

CONCEPT OF EIA

DEFINITION

Environmental Impact Assessment (EIA) is a project specific tool used to identify and assess the actual and potential environmental implications of a project before the project commences.

INTRODUCTION

Environmental Impact Assessment (EIA) is a tool for assisting environmental management and for contributing to Sustainable Development.

The purpose of EIA is to identify potential environmental impacts from proposals, such as projects and programs, and to propose means to avoid or reduce the significant impacts.

EIA was developed formally in the 1970s and has been incorporated in the procedures of governments and major development organizations worldwide.

As a result it is important that people who may have any role in the design or planning of projects, or may be associated with deciding about their suitability, should be aware of EIA and how it operates in their local area.

MAIN FEATURES

Often required by law; policies; administrative orders; or regulations, EIA systematically identifies, predicts and assesses the actual and potential environmental consequences of a project, before the project is approved.

The EIA process ensures proponents take responsibility for minimizing the environmental impacts of their proposed project. Decision makers and other stakeholders use information generated from the EIA process to identify environmental management options and to decide if and how the proposed project will proceed.

A key feature of EIA is public participation. Used in many countries, the aim of EIA is to reduce the environmental impact of a project at the earliest possible stage during the project cycle, that is, during the planning stage.

WHILE EIA PROCESSES DIFFER BETWEEN COUNTRIES AND PROJECTS, THERE ARE SEVERAL COMMON COMPONENTS:

SCREENING - whether EIA is required or not; what details are required?

SCOPING - what are the issues and impacts of the project; who are the stakeholders; what is the current state of the environment.

IDENTIFICATION OF ALTERNATIVES - what alternatives exist?

IMPACT ANALYSIS - what are the environmental, social and other related impacts of the project.

MITIGATION AND IMPACT MANAGEMENT - how will the impacts be mitigated, reduced or managed.

SIGNIFICANCE - are the impacts acceptable.

PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) OR REPORT - documentation of the proposal, impacts, impact mitigation and management options, level of significance and

REVIEW OF EIS - EIS is open for public comment for a sufficient period of time.

DECISION-MAKING - public comments considered and a decision made whether to accept the proposal as is, modify the proposal or reject the proposal outright.

MONITORING AND REVIEW - develop an implementation plan; begin monitoring and review of the project.

SOME COUNTRIES ARE ATTEMPTING TO TAKE EIA BY FURTHER INTEGRATING IT INTO PLANNING MECHANISMS AND EXPANDING ITS SCOPE TO COVER SUSTAINABLE DEVELOPMENT AND CUMULATIVE EFFECTS.

Organizational Proponent

EIA began in 1970 with the introduction of the US National Environment Policy Act (NEPA).

AN ENVIRONMENTAL IMPACT ASSESSMENT IS USED TO PREDICT AND MANAGE THE ENVIRONMENTAL EFFECT WHICH A PROPOSED DEVELOPMENT ACTIVITY MAY

1 WHAT IS ENVIRONMENTAL IMPACT

Environmental impact is defined as any change to the **environment**, or to its components that may affect human health or safety, flora, fauna, soil, air, water, climate, natural or cultural heritage other physical structures, social, economical or cultural conditions

2

COMPREHENSIVE DESCRIPTION OF THE EA PROCESS : The various stages involved in the EA include the following:

4.1 PRE-SCREENING CONSULTATION

4.2 SCREENING

4.3 SCOPING

4.4 ENVIRONMENTAL IMPACT STUDY

4.5 REVIEWING

4.6 DECISION MAKING

4.7 A SYSTEMATIC EA FOLLOW UPS

4.1 PRE-SCREENING CONSULTATION

Pre-screening is not normally taken as a part of a stage in the EA process. However, its application is recommended in recognition of its importance to enhance the overall effectiveness of the EA System.

Pre-screening is a stage where the proponent and the respective environmental or sectoral agencies establish contact and hold consultation on how best to proceed with the EA.

The undertaking of a pre-screening consultation is advisable as it saves time and has a mutual understanding about the requirement.

4.2 SCREENING

Screening is the processes of determining whether or not a proposal requires EA and the level at which the assessment should occur.

At this stage a proponent initiates the process by submitting the project profile or an initial environmental examination report after undertaking an initial environmental assessment, to the relevant environmental agency.

THIS PROJECT PROFILE IS NORMALLY CALLED SCREENING REPORT OR INITIAL ENVIRONMENTAL EXAMINATION REPORT, THAT MAY DESCRIBE,

- the proposed activities and its potential impacts,
- characteristics of the location (sensitivity of the area),
- size (small, medium and large scale),
- degree of public interest,
- institutional requirement, Environmental enhancement and monitoring considerations,

THE OUTCOME OF SCREENING COULD BE ONE OF THE FOLLOWING:

- *No EA required*
- ***Preliminary Assessment* (PA) – preliminary assessment is applied to:**
- Projects with limited impacts,
- **Projects in which the need of EA is unclear, and**
- Proposals with inadequate information
- ***Full scale EA* – when there is sufficient ground for detail assessment.**

4.3. SCOPING

The scoping stage is the process of interaction. It aims at identification of:

- boundaries of EA studies,
- important issues of concerns,
- significant effects and factors to be considered,

Scoping consists:

- involve potentially affected groups,
- consider reasonable alternatives,
- evaluate concerns expressed,
- understand local values,
- determine appropriate methodologies,
- establish the terms of reference,

The outcome of scoping is a scoping report or Terms of Reference for undertaking full scale EA. Both of them require passing through reviewing process.

SCOPING REPORT SHOULD INCLUDE AS A MINIMUM:

- a brief description of the project,
- all alternatives identified,
- issues raised by IAPs
- description of the public participation,

OUTLINE OF A TERM OF REFERENCE:

- background to the proposal,
- setting the context of the problem,
- consideration of alternatives,
- institutional and public involvement,
- required information regarding project and location, etc,,
- analysis of impacts,
- mitigation and monitoring, and
- conclusions and recommendations,

4.4 ENVIRONMNTAL IMPACT STUDY

PURPOSE OF EA

The purpose of undertaking Environmental Impact Study is to generate sufficient information on significant impacts.

ENVIRONMENTAL IMPACT STUDY INVOLVES:

- Impact Prediction
- Impact analysis
- Consideration of alternatives
- preparation of management plan (mitigation, monitoring activities)
- preparation of contingency plan

ASSESSING IMPACTS CHARACTERISTICS SHOULD:

- be carried out with values of significance,
- compare all feasible alternatives,
- document the values and beliefs on which judgments are based, and
- based on acceptable methodology, research and experimental findings.

IMPACT SIGNIFICANCE CRITERIA INCLUDE:

- ecological importance,
- social importance,
- environmental standards,
- statistical significance,
- experimental findings, etc

Design Of Mitigation Measures:

MITIGATION SEEKS TO:

- find better ways of doing things,
- minimize or eliminate negative impacts,
- enhance benefits, and
- protect public and individual rights to compensation,

MITIGATION OPTIONS:

- alternative ways of meeting the needs,
- changes in planning and design,
- improving monitoring and management,
- monetary compensations,
- performance bond,
- replacing, relocating, rehabilitating, etc.

IMPACT MANAGEMENT PLAN SHOULD:

- state policy and standards,
- indicate environmental effects, the issue and activity required to address it,
- define responsibilities, provide a schedule of tasks,
- include a system of reporting,
- include a system for monitoring and auditing,

- indicate resources required for completion and where relevant actual costs, including training and equipment needs,
- describe the proposed mitigation measures,
- Contain a contingency plan, etc.

4.5 REVIEWING

The purpose of review is to examine and determine whether the EIA-report is an adequate assessment of the environmental effects and of sufficient relevance and quality for decision-making.

Five hard copies and an electronic copy should be submitted to the relevant reviewing authority or agency as the case may be.

Reviewing conducted at various stages in the EA processes.

Reviewing conducted at various stages in the EA processes.

THIS INCLUDES REVIEWING OF:

- screening report;
- scoping report;
- Terms of Reference (TOR)
- Environmental impact assessment report, and
- Performance (monitoring or audit) reports at different stages in the project cycle.

REVIEWING MAY INCLUDE CONSIDERATIONS OF THE ADEQUACY OF:

- compliance with the "approved TOR",
- required information,
- the examination of alternatives, assessment of impacts, appropriateness of mitigation measures and monitoring schemes as well as implementation arrangements,
- the use of scientific and analytical techniques,

- the extent of public involvement and reflection of IAPs concerns, and
- Presentation of the information to decision makers at Regional, Sectoral, and Local levels.

NB. Reviewing will be made based on reviewing guidelines prepared by EPA. For detail information and requirements consult this guideline.

4.6. DECISION MAKING

EIA is an ongoing process of review, negotiations and incremental decision-making at various levels of the project cycle, about whether or not the proposal is to proceed, and under what conditions. Decision-making should be consultative, participatory and influence others to behave responsibly and sustainably.

It should also acknowledge and implement mandates and responsibility.

THE GUIDING PRINCIPLES OF APPROVAL PROCEDURE ARE, THAT:

- full scale assessment is required where the project is known to have significant adverse environmental impacts,
- preliminary EA is required where the project may have environmental impacts,
- EA is not necessary where the project is unlikely to cause significant environmental impacts,

- there is a need to adhere to precautionary principle. When determining the impacts of a project if both beneficial and detrimental effects are on balance, only slightly or arguably beneficial, it should be decided as it is likely to entail a negative significant impact,
- all projects contravening government policies or other legal obligations should be rejected from the outset.

- decisions are to be made in a step wise manner upon a successful implementation of environmental requirements based on stages in EA process and corresponding stages in the project cycle,

POSSIBLE DECISIONS INCLUDE:

- request for supplementary, or new EA report;
- approval of the EA report or performance reports at various stages in the project cycle;
- approval of the implementation of the proposal with or without conditions;
- approval subject to ongoing investigation;
- rejection;

IMPORTANT CONSIDERATIONS OF DECISION MAKING :

- a summary of evaluation is made available to the public;
- reasons for decision and conditions of approval are made public;
- there is the right of appeal against decision;
- approval can be reversed or permit can be revoked on the advent of changing circumstances,

- approval of a proposal cannot immune the proponent from being accountable of the occurrence of adverse significant impacts in the course of the implementation of the project, and

Approval of an EIA report is only mark a simple agreement to the proposal. The culmination of the approval procedure will be the issuance of an Environmental Clearance Certificate upon the satisfactory trial operation phase.

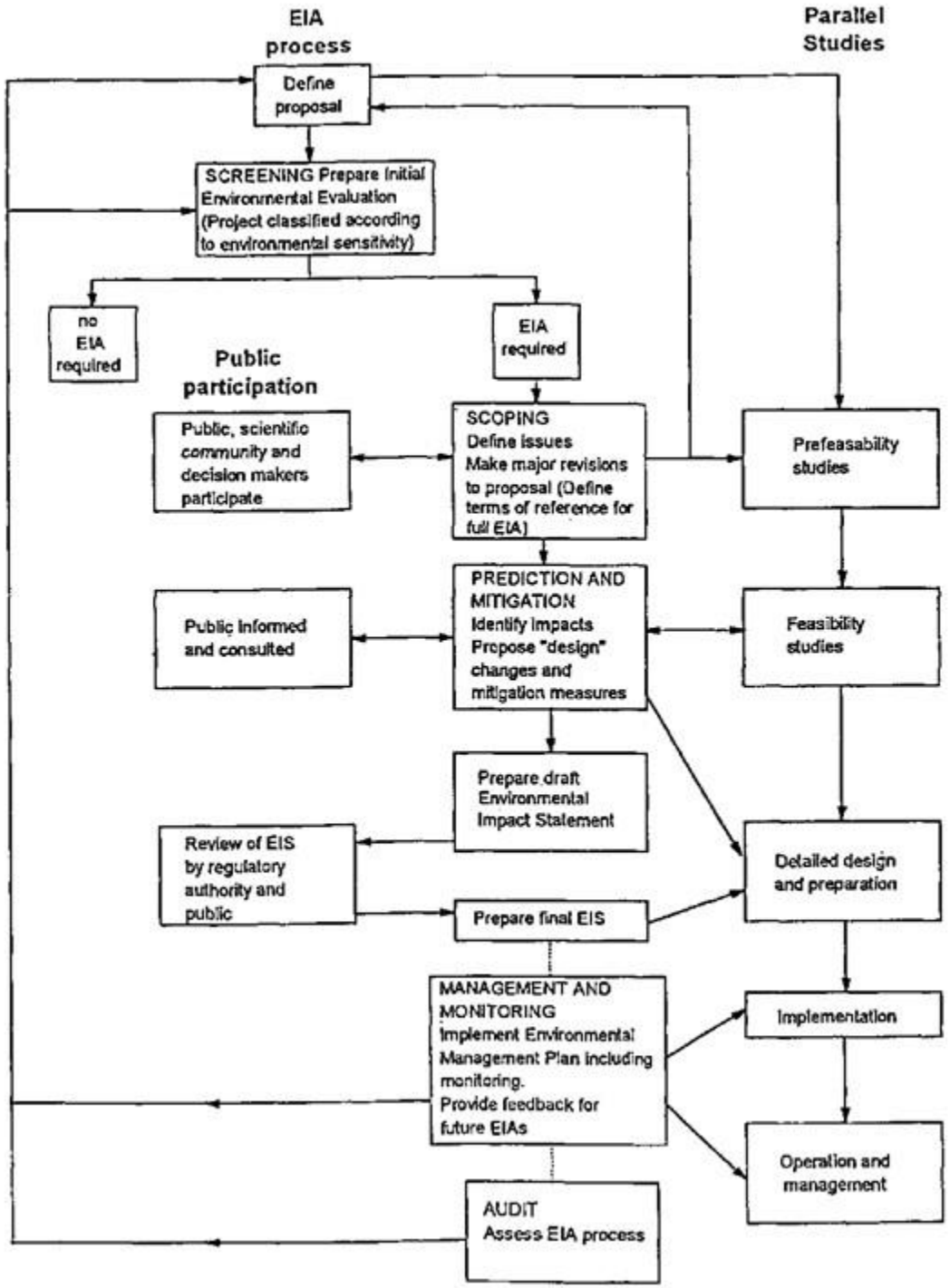
4.7. A SYSTEMATIC EIA FOLLOW-UPS

SYSTEMIC FOLLOW-UPS ACTIVITIES ARE NEEDED:

- to ensure that the anticipated impacts are maintained within the levels predicted,
- to see that the unanticipated impacts are managed and or mitigated before they become problems,
- to realize and optimize the benefits expected, and
- to provide information for a periodic review & alteration of impact management plan & enhance environmental protection through good practice at all stages of the project.

IT IS THEREFORE NECESSARY THAT:

- Environmental Management System, including internal monitoring schemes established,
- External audit conducted,
- Mechanism for regular risk communication designed, etc.


EIA process
Parallel Studies
Define proposal
SCREENING Prepare Initial Environmental Evaluation (Project classified according to environmental sensitivity)
no EIA required
EIA required
Public participation
Public, scientific community and decision makers participate
SCOPING Define issues Make major revisions to proposal (Define terms of reference for full EIA)
Prefeasability studies
Public informed and consulted
PREDICTION AND MITIGATION Identify impacts Propose "design" changes and mitigation measures
Feasibility studies
Prepare draft Environmental Impact Statement
Review of EIS by regulatory authority and public
Prepare final EIS
Detailed design and preparation
MANAGEMENT AND MONITORING Implement Environmental Management Plan including monitoring. Provide feedback for future EIAs
Implementation
Operation and management
AUDIT Assess EIA process

CHAPTER V

ENVIRONMENTAL POLICIES AND LEGISLATION

Dr Bhupender Singh Sandher, Faculty of WSEE, AWIT, AMU

CHAPTER 5: ENVIRONMENTAL POLICIES AND LEGISLATION

5.1. ENVIRONMENTAL POLICIES IN ETHIOPIA

5.2. ENVIRONMENTAL LAWS IN ETHIOPIA.

Environmental Policy and EIA Proclamation in Ethiopia

In 1994, Ethiopia incorporated environmental rights for first time in the history of the country in its constitution. To realize the constitutional environmental rights to a clean and healthy environment a number of steps have been taken by the government. Among these steps, the government has enacted environmental policy in 1997.

The 1997 environmental policy is divided into various parts in order to protect and manage the effects that would occur to the environment. It starts by discussing resource bases and the need for policy, the general and specific objectives, and finally discusses the sectoral environmental policies.

NEED FOR POLICY: The Government of the Federal Democratic Republic of Ethiopia (FDRE) has established a macro economic policy and strategy framework. Sectoral development policies and strategies have been, or are currently being, formulated**. Environmental sustainability** is recognized in the constitution and in the national economic policy and strategy as a key prerequisite for lasting success.

In the policy, **the general objectives** are declared precisely as;

The overall policy goal is to **improve and enhance the health and quality of life** of all Ethiopians and **to promote sustainable social and economic development** through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

SPECIFIC POLICY OBJECTIVES:

- Ensure that essential ecological processes and life support systems are sustained and used and where possible enhanced so that the satisfaction of the needs of future generations is not compromised;
- Ensure that the benefits from the non-renewable resources are extended to the future and the negative impacts are minimized.
- Identify and develop natural resources that are currently underutilized.

- Considering the social and environmental costs and benefits which cannot currently be measured in monetary terms such that their value is known.
- Improve the environment of human settlements to satisfy the physical, social, economic, cultural and other needs of their inhabitants on a sustainable basis.
- Raise public awareness and promote understanding of the essential linkages between environment and development.

LEGAL INSTRUMENTS CONCERNING EIA IN ETHIOPIA

Unlike most international Conventions, and Agreement, the 1995 FDRE constitution is the binding instrument discerns EIA in Ethiopian legal system to be considered on various development projects, plans and programs designed to be established in Ethiopia for the first time in history.

The FDRE constitution under chapter ten titled as ‘National policy principles and objectives’ provides EIA as a legal framework. It makes EIA a prerequisite for any policy, programs and projects designed in the country taking into considerations their impacts have on the environment

It also stresses the need of public participation to be fully consulted and expressed their views at the time of planning and implementation of environmental policies and projects that would affect them directly or indirectly.

THE POWERS AND RESPONSIBILITIES OF ENVIRONMENTAL PROTECTION AUTHORITY (EPA)

To prepare, review and update environmental policies, strategies and laws in consultation with the competent agencies, other concerned organs and the public at large and upon approval, monitor and enforce their implementation;

Establish a system for environmental impact assessment of public and private projects, as well as social and economic development policies, strategies, laws, and programmes;

review EIS reports of projects which are subjected to federal licensing, execution or supervision or inter- regional impacts and notify its decision to the concerned licensing agency and audit and regulate their implementation in accordance with the conditions set out during authorization;

provide financial as well as technical support to any organization or individual having as its objective the management and protection of the environment;

Provide advice to competent agencies regarding the discharge of their obligations under this Proclamation or under other laws pertaining to environmental protection and give recommendations to the government regarding measures necessary to ensure compliance;

Delegate some of its powers and duties, as it may be deemed appropriate, to other agencies.

Powers and responsibilities of Regional Environmental Agencies

The Regional Environmental Agencies or their equivalent Competent Authority is also duty bound in protecting the environment. This proclamation requires regional states to set up or design their own independent environmental agency in line with the Ethiopian environmental policy and conservation strategy. The regional environmental agencies are responsible for coordinating the formulation, implementation, review and revision of regional conservation strategies, environmental monitoring, protection, regulation and also ensuring the implementation of federal environmental standards or, as may be appropriate, issue and implement their own environmental laws in no less stringent standards.

Despite the binding nature of EIA procedural guidelines, the responsibilities of REAs are discussed in detail. Among its responsibility, it says that, in the Environmental Impact Assessment Process the Regional Environmental Agencies or their equivalents are responsible to adopt and interpret federal level EA policies and systems or requirements in line with their respective local realities, establish a system for EA of public and private projects, as well as social and economic development policies, strategies, laws, or programs of regional level functions; administer, oversee, and pass major decisions regarding impact assessment of:

- project subjects to licensing by regional agency
- project subjects to execution by a regional agency
- project likely to have regional impacts

5.2 Legal and policy context

The concept of sustainable development and environmental rights are enshrined in article 43,44 and 92 of **the Constitution of FDRE**.

In Article 43: The Right To Development, where peoples' right to:

- ✓ improved living standards and to sustainable development,
- ✓ participate in national development and, in particular, to be consulted with respect to policies and projects affecting their community, and
- ✓ the enhancement of their capacities for development and to meet their basic needs, are boldly recognized.

Similarly, in article 44: Environmental Rights, all persons are entitled to:

- ✓ live in a clean and healthy environment,
- ✓ Compensation, including relocation with adequate state assistance.

Moreover, in article 92: Environmental objectives it is declared that,

- ✓ government shall ensure that all Ethiopians live in a clean and healthy environment,
- ✓ programs and projects design shall not damage or destroy the environment,
- ✓ peoples have the right to full consultation and expression of views, and
- ✓ government and citizens have the duty to protect the environment.

"Environmental Protection organs Establishment proclamation (proc.no.295/2002)" has stipulated the need to establish a system that enables to foster coordinated but differentiated responsibilities among environmental protection agencies at federal and regional levels. The proclamation has also required the establishment of Sectoral and Regional Environmental, Units and Agencies, respectively. This shows that institutionalizing and mainstreaming environmental concerns has a legal foundation.

The Environmental Impact Assessment Proclamation (Proc. no. 299/2002) has made EA to be a mandatory legal prerequisite for the implementation of major development projects, programs and plans. This proclamation is a proactive tool and a backbone to harmonizing and integrating environmental, economic, cultural, and social considerations into a decision making process in a manner that promotes sustainable development.

The "Environmental Pollution Control Proclamation (Proc. no. 300/2002)" is promulgated with a view to eliminate or, when not possible to mitigate pollution as an undesirable consequence of social and economic development activities. This proclamation is one of the basic legal documents, which need to be observed as corresponding to effective EA administration.

The **Environmental Policy of Ethiopia (EPE, 1997),** provides a number of guiding principles that indicate and require a strong adherence to sustainable development. In particular EA policies of EPE includes, among other things, the need to ensure that EA:

- considers impacts on human and natural environments,
- provides for an early consideration of environmental impacts in projects and programs design,

- recognizes public consultation,
- includes mitigation plans and contingency plans,
- provides for auditing and monitoring,
- is a legally binding requirement,
- is institutionalize, etc

The Key Guiding Principles are:

a) Every person has the right to live in a healthy environment;

b) Sustainable environmental conditions and economic production systems are assured through the acquisition of power by communities to make their own decisions on matters that affect their life and environment;

c) The development, use and management of renewable resources shall be based on sustainability;

d) The use of non-renewable resources shall be minimized and where possible their availability extended (e.g. through recycling);

f) Social equity shall be assured particularly in resource use;

SECTORAL ENVIRONMENTAL POLICIES

***Water Resources*:** The Policies are

A) To ensure that the control of environmental health hazards be a necessary condition in the design, construction and use of dams and irrigation systems;

B) To recognize wetlands and upstream forests are fundamental in regulating water quality and quantity.

C) To ensure that any proposed introduction of exotic species into water ecosystems be subject to detailed ecological studies and environmental impact assessment;

D) To promote the protection of the interface between water bodies and land (e.g. lake shores, river banks and wetlands);

E) To involve water resource users, particularly women and animal herders, in the planning, design, implementation to carry them out without affecting the ecological balance;

F) To recycle waste water when it has been found to be safe for health and the environment.

Energy Resource: The Policies are

1. To adopt a process that integrates energy development with energy conservation, environmental protection and sustainable utilization of renewable resources.

2. To promote the development of renewable energy sources and reduce the use of fossil energy resources for sustainability and for protecting the environment, as well as for the future;

3. To encourage Government leases for private entrepreneurs to plant fuel woodlots in peri-urban areas;

- To make institutions and industries which consume large amounts of wood fuel establish their own plantations or make contractual arrangements with plantations to meet their wood requirements;
- To recognize that water resources play an important role to meet Ethiopia's energy demand and that, by generating power cause no pollution on the environment;
- To locate, develop, adopt or adapt energy sources and technologies to replace biomass fuels.

Control of Hazardous Materials and Pollution From Industrial Waste: The policies are

A)To adhere to the principle of minimizing and where possible preventing discharges of harmful substances that could be harmful, and to disallow the discharge when they are likely to be hazardous;

B) To adopt the "polluter pays" principle

C) To establish clear linkages between the control of pollution and other policy areas.

D) To provide adequate regulation of agricultural (crop and livestock) chemicals and micro-organisms;

E) To ensure that pollution control is commensurate with the potency, longevity and potential to increase or reproduce of the pollutant;

F) To establish safe limits for the location of sanitary landfill sites in the vicinity of wells, bore holes and dams, and issue regulations to enforce them;

G) To foster better understanding of the dangerous effects of chemicals and organisms and their fragments through the provision of information in a form understandable to users.

Atmospheric Pollution and Climate Change: The policies are

A) To promote a climate monitoring programme as the country is highly sensitive to climatic variability;

B) To recognize that even at an insignificant level of contribution to atmospheric greenhouse gases a firm and visible commitment to the principle of containing climate change is essential.

C) To recognize that Ethiopia's environmental and long-term economic interests and its energy prospect coincide with the need to minimize atmospheric inputs of greenhouse gases as it has a large potential for harnessing hydro-, geothermal and solar energy, none of which produce pollutant gases in significant amounts and to develop its energy sector accordingly;

D) To actively participate in protecting the ozone layer since, as the highlands of Ethiopia already have a thin protective atmosphere and are liable to suffer agricultural losses and adverse health effects from exposure to ultraviolet rays;

Land Use Plan

The Policy is: To ensure that Federal, Regional and Community Strategic Land Use Plans (SLUP) define broad land use and land user categories together with generalized resource management recommendations which can then be used to guide the formulation of detailed local resource use and management plans by individuals or community.

ASSIGNMENT

ASSIGNMENT 1 **(4 Marks)**

CHAPTER 1

1a) Types of water pollutants

1b) Different control measure of land pollution.

1c) Effects of air pollution.

ASSIGNMENT 2 **(4 Marks)**

CHAPTER 2

2a) What is greenhouse and its effect on global warming?

2b) Effect of acid rain on plants or vegetation.

2c) Short note on Ozone depletion.

ASSIGNMENT 3 **(4 Marks)**

CHAPTER 3

3a) Role of recycling on solid waste management.

3b) Define composting. Explain in detail In-vessel composting.

3c) Short note on Vermicomposting.

GROUP ASSIGNMENT

(8 Marks)

I. **Environmental Impact Assessment Report For Grand Renaissance Dam**

II. **Environmental Impact Assessment Report For Arbaminch textile Mill.**

III. **Environmental Impact Assessment Report For Road Project.**

IV. **Environmental Impact Assessment Report For Airport.**

V. **Environmental Impact Assessment Report For Thermal Power Project.**

Thank You