

Basics, Pollution and Waste Management

- **Environment:-**

The word “Environment” is originated from French, **environ** means ‘around’ or ‘to surround’ or ‘to encompass’. This means that environment includes things or objects or events that surround us. But this definition is not enough. It is the interaction between living beings (plants and animals) and its environment that includes physical non-living components like oceans or land or mountains. It also includes interaction among living beings. **It is thus a multidirectional system of interactions and this system is made up of living organisms and non-living physical components like air, water and land of our planet earth and its associated features like weather, waves and tides.**

- **Elements of Environment:-**

Environment is constituted by the interacting systems of physical, biological and cultural elements Inter related in various ways, individually as well as collectively. These elements are:

1. Physical elements: Physical elements are as space, landforms, water bodies, climate soils, rocks and minerals. They determine the variable character of the human habitat, its opportunities as well as limitations.

2. Biological elements: Biological elements such as plants, animals, micro-organisms and men constitute the biosphere.

3. Cultural elements: Cultural elements such as economic, social and political elements are essentially manmade features.

- **What is Environmental Science?**

- ✓ Environmental science is the study of the interactions between the physical, chemical, and biological components of the natural world, including their effects on all types of organisms and how humans impact their surroundings.
- ✓ Environment is everything that affects an organism during its lifetime. From a human point of view, environmental issues involve concerns about science, nature, health, employment, profits, law, politics, ethics, fine arts, and economies.

- **Meaning of Environmental Pollution**

- ✓ Environmental pollution means the introduction of different harmful pollutants into certain environment that makes this environment unhealthy to live in.
- ✓ The most common pollutants are usually chemicals, garbage, and waste water. Environmental pollution is happening in many parts of the world, especially in form of air and water pollution.
- ✓ The best example for air pollution is some of China’s cities, including capital Beijing, and the best example for water pollution is India with its Ganges river pollution problem.
- ✓ Environmental pollution is the build-up and concentration of toxic levels of chemicals in the air,

water, and land, which reduces the ability of the affected area to support life. Pollutants may be gaseous—ozone and carbon monoxide.

- ✓ **Example:** Liquid discharge from industrial plants and sewage systems; or solid-landfills and junkyards.
- The atmosphere is being polluted by the discharge of emissions originating from industrial plants, domestic sources, mobile vehicles and thermal power plants. Both in the developed and developing countries, the urban areas in particular, are exposed to such levels of atmospheric pollution that cause serious hazard to public health and hygiene. Presence of sulphur oxides, nitrogen oxides and toxic particulate substances in atmosphere have caused harmful influence on man and other living beings.
- Pollution depicts the substances (**pollutants**) which are released into the environment because of human activities that can be either deliberate or accidental. Human activities, whether industrial production or others like sewage, result in the change in the ambient quality of the environment. In the production process, certain substances (wastes) are re-recycled or produced in the form of emissions/effluents and they impact the environment leading to damage to humans and ecosystem.
- Pollution of the environment is causing great damage to ecosystem that depends upon the health of this environment. Water pollution according to some estimates cause 14,000 deaths each day in the world, most of them in India. Many developed countries have introduced certain laws to not only regulate various types of pollution but also the laws to mitigate the adverse effects of pollution.
- Pollution levels need to be controlled all the time if we want to keep our environment safe and healthy. Without proper pollution control environment soon becomes unhealthy. Preventing introduction of pollutants into some environment is the best way to protect environment from pollution.
- Some of the **environmental problems** are pollution, soil erosion leading to floods, landslides, change of river directions, extinction of species, and vulnerable ecosystem in place of more complex and stable ecosystems, depletion of natural resources, waste accumulation, deforestation, thinning of ozone layer and global warming.
- The environmental problems are visualized in terms of pollution, growth in population, development, industrialization, unplanned urbanization etc. Rapid migration and increase in population in the urban areas has also lead to traffic congestion, water shortages, solid waste, and air, water and noise pollution are common noticeable problems in almost all the urban areas since last few years.
- **Pollutants** are generally grouped under **two** classes:
 - (a) **Biodegradable pollutants:** Biodegradable pollutants are broken down by the activity of Microorganisms and enter into the biogeochemical cycles.

Example: Such pollutants are domestic waste products, urine and faecal matter, sewage, agricultural residue, paper, wood and cloth etc.

(b) **Non-Biodegradable pollutants:** Non-biodegradable pollutants are stronger chemical bonds, do not break down into simpler and harmless products.

Example: These include various insecticides and other pesticides, mercury, lead, aluminium, plastics, radioactive waste etc.

- **Air Pollution:-**

- ✓ Air pollution is a problem at local or national level but sometime it may originate in one country and may engulf the neighbouring countries.
- ✓ It seems that earliest effort at air pollution control was made by the WHO (World Health Organisation) Conference in 1957-58. It is known as "Clean Air Conference".
- ✓ In 1974 some of the major industrial countries of the world (19 European countries, Australia, Canada and Japan) convened a meeting for the control of air pollution. In this meeting **two basic principles** were evolved:
 - (i) Polluter must pay for pollution, and
 - (ii) Trans-frontier air pollution should be controlled.
- ✓ The principle that 'polluter must pay for pollution' laid down that the industry where pollution originates must pay for its control.
- ✓ The **second concept** says that the aim should be the welfare and preservation of health, not only of people of one state but of people throughout the world. And protection should be of total environment for the good of mankind and other living beings of the planet.

- **Causes of Air Pollution**

- ✓ Air pollution is the introduction into the atmosphere of chemicals, particulates, and biological matter that cause harm to humans, other living organisms, or cause damage to the natural environment.
- ✓ Stratospheric ozone depletion (contributed to air pollution) has long been recognized as a threat to human health as well as to the Earth's ecosystems. The Earth is capable of cleaning itself of a certain level of pollution, but man-made pollutants have become too numerous for the Earth's natural mechanisms to remove. We are seeing the results of this overload in the form of acid rain, smog, and the variety of health problems that can be contributed to our environment.
- ✓ One of the main causes of air pollution is **manufacturing**. This source of pollution spews particulate matter and chemicals into the atmosphere. The exhaust from a factory includes, sulphur oxides, nitrogen oxides, carbon monoxide and dioxide, as well as volatile organic compounds and particulates.
- ✓ There is not an area of the Earth's atmosphere or an ecosystem that has not been altered by the long term effects of the pollution created by manufacturing. The burning of fossil fuels is a part of the everyday life of every human on the planet. We burn fossil fuels in our cars, fossil fuel is burned to extract fossil fuel from the Earth, and fossil fuel is used to process fossil fuel into its individual

components. Each step in the process increases the number of asthma cases in the world, raises a person's chance of having cancer, and increases the chance that your child will be born with congenital defects.

- **Effects of Air Pollution**

- ✓ A variety of air pollutants have known or suspected harmful effects on human health and the environment. Pollutants from these sources may not only prove a problem in the immediate vicinity of these sources but can travel long distances. **Like** photochemical pollutants, sulphur oxides contribute to the incidence of respiratory diseases. Acid rain, a form of precipitation that contains high levels of sulphuric acids, can contaminate drinking water and vegetation, damage aquatic life, and erode buildings.
- ✓ When a weather condition known as a **temperature inversion** prevents dispersal of smog, inhabitants of the area, especially children and the elderly and chronically ill, is warned to stay indoors and avoid physical stress. Even everyday levels of air pollution may insidiously affect health and behavior. Indoor air pollution is a problem in developed countries, where efficient insulation keeps pollutants inside the structure.
- ✓ Air pollution may possibly harm populations in ways so slow that they have not yet been detected. For that reason research is now under way to assess the long-term effects of chronic exposure to low levels of air pollution—what most people experience—as well as to determine how air pollutants interact with one another in the body and with physical factors such as nutrition, stress, alcohol, cigarette smoking, and common medicines. Another subject of investigation is the relation of air pollution to cancer, birth defects, and genetic mutations.
- ✓ Result of air pollution are seasonal “holes” in the ozone layer in the atmosphere above Antarctica and the Arctic, coupled with growing evidence of global ozone depletion. This can increase the amount of ultraviolet radiation reaching the earth, where it damages crops and plants and can lead to skin cancer and cataracts. This depletion has been caused largely by the emission of chlorofluorocarbons (CFCs) from refrigerators, air conditioners and aerosols.
- ✓ Many different chemicals in the air affect the human body in negative ways. People are exposed to so many potentially dangerous pollutants, it is often hard to know exactly which pollutants are responsible for causing sickness. Also, because a mixture of different pollutants can intensify sickness, it is often difficult to isolate those pollutants that are at fault. Diseases such as bronchitis, lung cancer, and heart disease may all eventually appear in people exposed to air pollution. Here, we will sum up and briefly explain the **main environmental effects** of air pollution:

1. Acid Deposition

Acid deposition is not merely characterized as acid rain; it can also be snow and fog or gas and dust. Acid deposition mainly forms during fossil fuel combustion. When emissions of sulphur dioxide and nitrogen oxides come in contact with water, they will become sulphuric acid and nitric acid. This has a number of consequences:

- Availability of nutrients and metal spores is likely to decrease.

- When acidity is high more metals will dissolve in water. This can cause surface water to become polluted, which has serious health effects on aquatic plants and animals.

Example: High aluminium (Al) concentrations can complicate nutrients uptake by plants. This makes aluminium one of the prior causes of forest decay. Mercury can be dispersed by transport through surface water, causing it to accumulate in fish. Buildings and monuments may be damaged through erosion.

2. Eutrophication

Eutrophication is caused by an increase in plant nutrients in water. The higher availability of nutrients causes certain water plants, such as algae and duckweed, to grow so extensively. This blocks sunlight supplies to water. The plants also use all available oxygen supplies, which will not be renewed because heterotrophic plants and bacteria need light to perform photosynthesis.

Eutrophication causes ecosystem disruption.

3. Smog

- ✓ Smog is a **combination** of the words **smoke and fog**. We can distinguish two separate types of smog, summer smog and winter smog.
- ✓ Photochemical smog, or **summer smog**, mainly consists of ozone. It is a brown, oxidising fog. The causes of photochemical smog are due to traffic and industries. These contaminants cause eye and respiratory irritations. Plants are extremely vulnerable to ozone. Even in low concentrations it can cause serious damage.
- ✓ **Winter smog** is also referred to as **acid smog**; it mainly consists of foggy elements. Winter smog is found in areas where vertical dispersion of air pollutants is not possible. In winter, ground temperatures are sometimes lower than those of the upper atmospheric layers, causing the air to stay near the ground, so that pollutants will not spread. This causes winter smog. Aerosols in air play a part in this process, because they serve as condensation cores for water vapour. Acid smog causes breathing problems and eye irritations.

4. Ozone Loss

- ✓ Ozone is created everywhere in the atmosphere through chemical reactions under the influence of UV-light. Ozone is decomposed under the influence of visible light and UV-A light. During ozone decomposition an oxygen-poor molecule is released, which aids the breakdown of ozone. The decomposition and production of ozone is a natural process. However, human activities have caused large concentrations of ozone-decomposing chemicals to enter the atmosphere, causing the natural balance to be disrupted.
- ✓ Ozone is very important for all life on earth, because it absorbs harmful UV-B radiation from the sun. When the ozone concentrations in this layer decrease, UVB radiation may reach the earth. This radiation damages DNA and causes skin cancer. The radiation can also damage the human immune system. UV-B radiation also causes cataract and nearsightedness. The radiation can decrease growth and photosynthesis activity in a number of plants. Primary crops, such as rice, corn and sunflower are very susceptible to this. Trees are also susceptible to the radiation.
- ✓ UV-B radiation can affect aquatic life up to twenty meters under the water surface.

- **Measures to Control Air Pollution:-**

- ✓ Air pollution control helps to keep the environment clean. In order to reduce the amount of air pollution that is allowed to escape into the environment, various pollution control measures must be taken by individuals and industries alike.
- ✓ **Activated carbon** is one of the most popular forms of air pollution control. This type of control involves the use of a pollution filter, carbon, to reduce the amount of pollutants that are allowed to escape into the air. When in use, these filters absorb pollutants helping to cleanse the air of any possible toxins.
- ✓ **Bio filtration** is another effective type of air pollution control. It uses microorganisms, often bacteria and fungi, to dissolve pollutants. Industries that employ bio filtration systems include food and waste plants, pharmaceutical companies, and wastewater management facilities. While this method of air pollution control works rather well, a large space is required in order to operate a bio filtration system. Many industries do not have this amount of available space, so this method is often disregarded.
- ✓ Since car engine **emissions** are responsible for a large portion of air pollution, various measures must be taken in order to reduce these emissions. Often, catalytic oxidizers are placed inside of car exhaust systems. These oxidizers help to reduce the amount of emissions that a car creates. Scientists are currently working on a way to reduce vehicle emissions completely, though a practical version this type of air pollution control is not yet available.
- ✓ In order to reduce global air pollution, many environmental experts believe that all countries across the world should have the same emissions standards. This way, air pollution can be managed on a global level. Presently, a worldwide emissions standard has not been established, though many are hopeful that this will change within the near future.

Water Pollution: Causes, Effects and Control Measures

- **Meaning of Water Pollution:-**

- ✓ Water pollution can be defined as the contamination of the water bodies when pollutants are released into the water without thorough treatment and removal of harmful components. It not only affects the environment and human well-being, but also disrupts the balance of the ecosystem.
- ✓ Here are some of the **major effects of water defilement on man and the environment**. When toxic substances enter lakes, streams, rivers, oceans, and other water bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water whereby the quality of the water deteriorates, affecting aquatic ecosystems. Pollutants can also seep down and affect the groundwater deposits.

- ✓ Water pollution has many sources. The most polluting of them are the city sewage and industrial waste discharged into the rivers. The facilities to treat waste water are not adequate in any city in India. Presently, only about 10% of the waste water generated is treated; the rest is discharged as it is into our water bodies. Due to this, pollutants enter groundwater, rivers, and other water bodies. Such water, which ultimately ends up in our households, is often highly contaminated and carries disease-causing microbes.

- ✓ Agricultural run-off, or the water from the fields that drains into rivers, is another major water pollutant as it contains fertilizers and pesticides. Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water.

- ✓ The sources of water pollution are categorized as being a point source or a non-source point of pollution.

Point sources of pollution occur when the polluting substance is emitted directly into the waterway.

Example: A pipe spewing toxic chemicals directly into a river.

A non-point source occurs when there is runoff of pollutants into a waterway, **for instance** when fertilizer from a field is carried into a stream by surface runoff.

- **Various types of Water Pollution:**

1. **Toxic Substance:** A toxic substance is a chemical pollutant that is not a naturally occurring substance in aquatic ecosystems. The greatest contributors to toxic pollution are herbicides, pesticides and industrial compounds.
2. **Organic Substance:** Organic pollution occurs when an excess of organic matter, such as manure or sewage, enters the water. When organic matter increases in a pond, the number of decomposers will increase. These decomposers grow rapidly and use a great deal of oxygen during their growth. This leads to a depletion of oxygen as the decomposition process occurs. A lack of oxygen can kill aquatic organisms. As the aquatic organisms die, they are broken down by decomposers which lead to further depletion of the oxygen levels.
3. **Thermal Pollution:** Thermal pollution can occur when water is used as a coolant near a power or industrial plant and then is returned to the aquatic environment at a higher temperature than it was originally. Thermal pollution can lead to a decrease in the dissolved oxygen level in the water while also increasing the biological demand of aquatic organisms for oxygen.
4. **Ecological Pollution:** Ecological pollution takes place when chemical pollution, organic pollution or thermal pollution is caused by nature rather than by human activity.

Example:

1. When a large animal, such as a deer, drowns in a flood and a large amount of organic material is added to the water as a result.

2. Major geological events such as a volcano eruption might also be sources of ecological pollution.

Specific Sources of Water Pollution are as follows:

1. Farming

- Farms often use large amounts of herbicides and pesticides, both of which are toxic pollutants. These substances are particularly dangerous to life in rivers, streams and lakes, where toxic substances can build up over a period of time.
- Farms also frequently use large amounts of chemical fertilizers that are washed into the waterways and damage the water supply and the life within it. Fertilizers can increase the amounts of nitrates and phosphates in the water, which can lead to the process of eutrophication.
- Allowing livestock to graze near water sources often results in organic waste products being washed into the waterways. This sudden introduction of organic material increases the amount of nitrogen in the water, and can also lead to eutrophication.
- Four hundred million tons of soil is carried by the Mississippi River to the Gulf of Mexico each year. Excessive amounts of sediment in waterways can block sunlight, preventing aquatic plants from photosynthesizing, and can suffocate fish by clogging their gills.

2. Business

- Clearing of land can lead to erosion of soil into the river.
- Waste and sewage generated by industry can get into the water supply, introducing large organic pollutants into the ecosystem.
- Many industrial and power plants use rivers, streams and lakes to dispose of waste heat. The resulting hot water can cause thermal pollution. Thermal pollution can have a disastrous effect on life in an aquatic ecosystem as temperature increases decrease the amount of oxygen in the water, thereby reducing the number of animals that can survive there.
- Water can become contaminated with toxic or radioactive materials from industry, mine sites and abandoned hazardous waste sites. Acid precipitation is caused when the burning of fossil fuels emits sulphur dioxide into the atmosphere. The sulphur dioxide reacts with the water in the atmosphere, creating rainfall which contains sulphuric acid. As acid precipitation falls into lakes, streams and ponds it can lower the overall pH of the waterway, killing vital plant life, thereby affecting the whole food chain. It can also leach heavy metals from the soil into the water, killing fish and other aquatic organisms. Because of this, air pollution is potentially one of the most threatening forms of pollution to aquatic ecosystems.

3. Homes

- Sewage generated by houses or runoff from septic tanks into nearby waterways, introduce organic pollutants that can cause eutrophication.

- Fertilizers, herbicides and pesticides used for lawn care can runoff and contaminate the waterway. As with agricultural fertilizers, home fertilizers can lead to the eutrophication of lakes and rivers.
- Improper disposal of hazardous chemicals down the drain introduce toxic materials into to the ecosystem, contaminating the water supplies in a way that can harm aquatic organisms.
- Leaks of oil and antifreeze from a car on a driveway can be washed off by the rain into nearby waterways, polluting it.

Causes of Water Pollution

The causes of water pollution vary and may be both natural and anthropogenic. However, the most common causes of water pollution are the anthropogenic ones including:

- ✓ **Agriculture runoff:** carrying fertilizers, pesticides/insecticides/herbicides and other pollutants into water bodies such as lakes, rivers, ponds). The usual effect of this type of pollution consists in algae growing in affected water bodies. This is a sign of increased nitrates and phosphates in water that could be harmful for human health.
- ✓ **Storm water runoff:** carrying various oils, petroleum products and other contaminants from urban and rural areas (ditches). These usually form sheens on the water surface.
- ✓ **Leaking sewer lines:** may add tri halo methanes (such as chloroform) as well as other contaminants into groundwater ending up contaminating surface water, too. Discharges of chlorinated solvents from Dry Cleaners to sewer lines are also a recognized source of water pollution with these persistent and harmful solvents.
- ✓ **Mining activities:** Mining activities involve crushing the rock that usually contains many trace metals and sulphides. The left material may easily generate sulphuric acid in the presence of precipitation water. Please, read more at Mining Sites.
- ✓ **Foundries:** have direct emissions of metals (including Hg, Pb, Mn, Fe, Cr and other metals) and other particulate matter into the air. Please, read more at Foundry.
- ✓ **Industrial discharges** – may add significant pollution to water bodies, but are usually regulated today.
- ✓ **Accidental leaks and spills** – Associated with handling and storage of chemicals may happen anytime and, although they are usually contained soon after they occur, the risk of polluting surface and groundwater exist. An example are ship accidents such as Exxon Valdez disaster which spilled large amounts of petroleum products into the ocean; Intended/illegal discharges of waste – While such occurrences are less common today, they may still happen due to the high cost of proper waste disposal; illegal waste discharges into water bodies were recorded all over the world;
- ✓ **Burning of fossil fuels** – The emitted ash particles usually contain toxic metals. Burning will also add a series of oxides including carbon dioxide to air and respectively water bodies.
- ✓ **Construction activities** – introduce a series of contaminants into the ground that may eventually end up in groundwater.
- ✓ **Plastic materials/wastes in contact with water** – may degrade slowly releasing harmful compounds for both human health and ecosystem.

- ✓ **Disposal of personal care products and household chemicals (including detergents and various cleaning solutions)** – This is a serious problem since the releases to water are unpredictable and hard if not impossible to control. It is up to each of us to minimize this contribution to water pollution by controlling our consumption and disposal of such products as well as trying to recycle as much as we can!
- ✓ **Improper disposal of car batteries and other batteries** – may add metals.
- ✓ **Leaking landfills** – may pollute the groundwater below the landfill with a large variety of contaminants (whatever is stored by the landfill).
- ✓ **Animal wastes** – contribute to the biological pollution of water streams. Lack of awareness of humans is the primary cause of water pollution. Also dumping of garbage, oil spills, dumping of nuclear waste and passing waste in water sources are causes of water pollution.

- **Effects of Water Pollution**

Water pollution has been a cause of concern for decades. With urbanization, it has increased to such enormous levels that it now poses a threat to the existence of aquatic life and human health. The effects of water pollution are varied and depend on what chemicals are dumped and in what locations. Water pollution has number of effects. The effects could be classified as:

1. Effects on Ecosystem The effects of water pollution on ecosystem are as follows:

- (i) Besides inorganic nutrient input, with the inflow of waste water, decomposition of organic wastes, plant nutrients such as nitrates and phosphates takes place. This promotes the growth of oxygen consuming algae (algal bloom), especially the blue-green algae. The growth of oxygen consuming algae, which deoxygenates water killing fish and other animals, is referred to as eutrophication.
 - (ii) Addition of oxygen not sufficient to support life.
 - (iii) Addition of non-degradable broad-spectrum pesticides, which cause mass destruction.
 - (iv) Addition of oil destroys life by reducing oxygen and catching fire, destroying ecosystem. Biological oxygen demand or BOD stands for the amount of oxygen regained by the microorganisms of polluted water to complete the decomposition of organic matter present in the water. The term is usually used to know the amount of oxygen consumed. Higher in the amount of oxygen consumed, higher is the degree of organic pollutants. Shifts in biodiversity of animals and plants in polluted ecosystem.
- Imbalance in host - parasite relations in the ecosystem and changes in food - webs and food chains. Imbalances in microbial population and effects due to such imbalances.
 - Depositions of deleterious chemicals in soil leading to loss of soil fertility.

2. Effects on Animal Health

The effects of water pollution on animal health are as follows:

- (i) Large scale death of aquatic and terrestrial animals
- (ii) Reduced reproduction rate
- (iii) Increased incidence of diseases
- (iv) Imbalances created in secondary food chains
- (v) Accumulation of bio-accumulative and non-biodegradable pollutants in animal bodies.

3. Effects on Human Health

The effects of water pollution on human health are as follows:

- (i) Increased incidence of tumours, ulcers due to nitrate pollution
- (ii) Increased incidence of skin disorders due to contact with pollutants
- (iii) Increased incidence of constipation, diarrhoea and infections to intestine
- (iv) Dangerous effects on growing foetus in pregnant women
- (v) Still births, abortions and birth of deformed children.
- (vi) Reduced activity of immune system.
- (vii) Loss of memory power and reduced mental sharpness.
- (viii) Water borne diseases like jaundice, hepatitis, gastroenteritis will be more prevalent due to water pollution.
- (ix) Reduced bone development and muscular development.

Measures to Control Water Pollution

- With increasing urbanisation and expanding agricultural and industrial production, water pollution problems have progressively become more serious and necessitated the adoption of suitable control measures for controlling pollution.
- Approaches to controlling sources of water pollution may be grouped into **three** broad categories:

1. Minimisation of Pollutant Generation

- ✓ Reduction of the quantity of waste or pollutants generated by an activity is obviously the most desirable approach to pollution control. Since it conserves resources that would otherwise be wasted, and at the same eliminates the cost of removing pollutant after they are produced.
- ✓ As a general rule, a resource becomes a waste when it can no longer be economically utilised or recovered. In the past, decisions concerning resource usage or waste disposal have been governed largely by immediate economic considerations and have not always considered the effects of these actions on the quality of the environment.
- ✓ Minimising soil erosion by improved agricultural practices (e.g. by minimising surface runoff and leaving crop residues in the ground), more efficient use of nutrients and the development and use of biological pest control techniques in preference to the use of non-biodegradable toxic chemicals are some of the measures for minimising water pollution from agriculture.
- ✓ Development and use of non-polluting technology to modify or replace existing manufacturing processes, and recycling or recovering materials that would otherwise be wasted are two approaches which not only reduce pollutant generation, but can sometimes even result in a saving for the industry by minimising or eliminating the need for waste treatment for pollutant removal.
- ✓ Good house keeping practices, such as for example minimizing spillage and materials wastage, can also lead to waste reduction and savings in production cost.

2. Wastewater Treatments at Source

- ✓ In nature, a variety of different mechanisms operate to degrade and transform waste materials into stable, harmless end products such as carbon dioxide. When the quantities of wastes to be disposed of are large, however, the natural purification processes become overloaded and can no longer

assimilate the wastes without adversely affecting environmental quality. Man-made treatment systems are then needed to reduce pollutant loads to acceptable levels for discharge.

- ✓ These purification systems make use of the same mechanisms as in the natural environment to bringing about waste stabilisation.
- ✓ The multitude of different wastewater treatment technologies can be classified as **physical, chemical and biological processes**, depending on the nature of the purification mechanism employed. The character of the pollutants and the form (suspended or dissolved) in which they are present usually determine the most suitable process for their removal. **For example**, gross suspended solids and floatable materials such as oil and fat are readily removed by physical processes such as sedimentation or flotation respectively.
- ✓ **Biological Methods** are effective and economical when the waste water contains mostly biodegradable pollutants such as organic matter.
- ✓ **Chemical Treatment** is used when the pollutant of interest is non- biodegradable and is not amenable to removal by simple physical means (e.g. when it occurs in dissolved form). Heavy metals are typically removed by chemical precipitation.

3. In-situ Pollution Control

- ✓ Waste minimisation and treatment help prevent pollution from occurring and should be the principal approaches to water quality maintenance. Methods to facilitate this are collectively grouped under in-situ control techniques.

- **Soil Pollution: Causes, Effects and Control Measures**

The meaning, causes, effects and control measures of soil pollution are discussed below:

- **Meaning of Soil Pollution:-**
- ✓ Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease causing agents, which have adverse effects on plant growth and animal health.
- ✓ Soil is the thin layer of organic and inorganic materials that covers the Earth's rocky surface. The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost top soil. The inorganic portion made up of rock fragments, was formed over thousands of years by physical and chemical weathering of bedrock.
- ✓ Productive soils are necessary for agriculture to supply the world with sufficient food. Soil pollution mainly is a result of penetration of harmful pesticides and insecticides, which on one hand serve whatever their main purpose is, but on the other hand bring about deterioration in the soil quality, thus making it contaminated and unfit for use later. Insecticides and pesticides are not to be blamed alone for soil pollution, but there are many other leading causes of soil pollution too.
- ✓ The factors or substances which affect the soil are not static. It can be **positive or negative**. In the negative soil pollution there occur an overuse of soil and erosion. The erosion occurs by water and air.

- ✓ The water erosion occurs by the high speed rivers which remove the top layer of soil. It occurs near the hills. It may also occur due to the high speed winds which brings the particles of sand from dry areas. Nearly half of the land has become desert. Thar Desert of Rajasthan was a fertile land around thousand years back.

Example: The sand of Gujarat coast made the Thar Desert of Rajasthan into desert along with the overgrazing and felling of timber.

- ✓ The fertile land is also being affected by the roads, houses, unplanned development of houses, garbage, empty bottles, furniture and ash. These materials are dumped in an open area outside the town and they not only affect the land on which they are dumped but also the nearby land. It is also referred as the third pollution or landscape pollution. The best way to deal with this problem is to bury the waste in low lying areas. The garbage is burnt and is changed to the compost and the rubbish is recycled.

- **Causes of Soil Pollution**

- ✓ Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural oil environment. The occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.
- ✓ A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the soil or which disturbs the biological balance of the organisms in the soil. Pollution in soil has adverse effect on plant growth. Soil pollution is a result of many activities and experiments done by mankind which end up contaminating the soil.
- ✓ Here are some of the leading soil pollution causes: Industrial wastes such as harmful gases and chemicals, agricultural pesticides, fertilizers and insecticides are the most common causes of soil pollution.
 - Ignorance towards soil management and related systems.
 - Unfavorable and harmful irrigation practices.
 - Improper septic system and management and maintenance of the same.
 - Leakages from sanitary sewage.
 - Acid rains, when fumes released from industries get mixed with rains.
 - Fuel leakages from automobiles, that gets washed away due to rain and seep into the nearby soil.
 - Unhealthy waste management techniques, which are characterized by release of sewage into the large dumping grounds and nearby streams or rivers.

- **Effects of Soil Pollution**

- ✓ The effects of pollution on soil are quite alarming and can cause huge disturbances in the ecological balance and health of living creatures on earth. Some of the most serious soil pollution effects are:
 - Decrease in soil fertility and therefore decrease in the soil yield.
 - Soil contamination is the consequence of the introduction of various man-made chemicals that are present in concentrations at unacceptable levels.

1. Contaminated Soil Poses Health Risks

- ✓ Direct contact with soil that contains contaminants, inhalation of fumes or vapours from the pollutants, or ingestion of contaminated water from soil runoff may have an adverse impact on humans, animals, fowl, fish and other living organisms.
- ✓ Soil used to grow food for human consumption presents the biggest concern; however, soil found in school yards, parks and other locations where children may be in direct contact with polluted soil demands reclamation.

2. Soil Pollutants Unbalance the Ecosystem

- ✓ Soil contamination is often the result of leaching from landfills, the rupture of underground storage tanks, acidic precipitates, radioactive fallout, fuel dumping, direct discharge of chemicals. The effects of tainted soil on agriculture is demonstrated in reduced soil fertility, reduced crop yields, reduced atmospheric nitrogen fixation, erosion and unbalance in soil flora and fauna.

3. Tainted Soil Destroys Animal Life

- ✓ Contaminated soil may lead to the loss of domestic cattle, sheep and other animal food sources, as well as wildlife. Polluted, infertile soil increases the cost of crop production and can diminish wild vegetation that provides shelter and habitat to birds and small animals. When humans consume animals raised on feeds from polluted soil, health risks arise.

• Measures to Control Soil Pollution

- ✓ Since fertilizers and pesticides are useful in increasing crop production and protection from harmful organisms, their use cannot be discontinued. Therefore, the question arises as to how to use these toxic chemicals, so that their use may be fruitful but may not adversely affect soil fertility and the related environment.
- ✓ The following **measures** may be suggested to control soil pollution:
 1. Development of pesticides should be encouraged, which may save crops from pests and rodents but should not contaminate soil with toxic chemicals.
 2. Pesticides and fertilizers should be applied on croplands only in recommended dose, prescribed by Indian Standard Institution experts. It will help in reducing the level of water and soil pollution caused through these chemicals.
 3. There should be sufficient duration between the harvesting of crops and time of last spray of pesticides. This will help in reducing contamination of pesticides, directly to the crop.
 4. There must be arrangement for educating farmers regarding the proper use of pesticides and fertilizers. Only those fertilizers could be used for growing crops, which are deficient in soils.
 5. After every two or three years soils percentage should be analyzed, so that it can be observed that what is the percentage of nutrients in the soils? This will help in maintaining the required amount of nutrient in the soils.
 6. Waste water from industries should not be used for irrigation without eliminating toxic chemicals from the effluent. This will also reduce the concentration of unwanted substances in the soil.
 7. Garbage should not be disposed of on cultivated land without covering it with the soils.

8. Soil conservation practices should also be adopted so as to avoid loss of valuable nutrients through soil erosion.

In addition to this, government should encourage research programmers examining the effects of pesticides and fertilizers on soils and human beings. This will help in devising suitable measures to control soil pollution and restore its fertility.

- **Water Resources: An Overview:-**

- ✓ Water claims to be an important resource. An important use of water in our country is for irrigation. It is also required in large amounts for industrial and domestic consumption.
- ✓ The rainfall in India shows very high spatial and temporal variability and paradox of the situation is that Mousinram near Cherrapunji, which receives the highest rainfall in the world, also suffers from a shortage of water during the non-rainy season, almost every year.
- ✓ With rapid growing population and improving living standards the pressure on our water resources is increasing and per capita availability of water resources is reducing day by day. Overexploitation of groundwater is leading to reduction of low flows in the rivers, declining of the groundwater resources, and salt water intrusion in aquifers of the coastal areas.
- ✓ Over canal-irrigation in some of the command areas has resulted in water logging and salinity. The quality of surface and groundwater resources is also deteriorating because of increasing pollutant loads from point and non-point sources. The
- ✓ Adequate supply of safe water is essential for maintaining health and sanitary conditions. Agriculture production, through irrigated cultivation needs water. Likewise, labour productivity can be increased if the labour force and their families have adequate safe water supply.
- ✓ Sustainable management of water resources has implications for ecosystem, dams, silting of reservoirs, and submergence of forests, extinction of rare plants and animals and outbreak of disease. A systematic study of impact of water resource projects on environment has to be undertaken at national level. The people who are likely to be affected by projects - like river valley projects, water shed projects or dams - should be taken into confidence and even involved in project formulation and implementation.

- **Dams: Benefits and Problems**

- ✓ Today there are more than 45,000 large dams around the world, which play an important role in communities and economies that harness these water resources for their economic development.
- ✓ Current estimates suggest some 30-40% of irrigated land worldwide relies on dams. Hydropower, another contender for the use of stored water, currently supplies 19% of the world's total electric power supply and is used in over 150 countries.
- ✓ The world's two most populous countries –China and India –have built around 57% of the world's large dams. A number of big, medium and minor dams have been envisaged under different river valley projects. These dams have been undertaken for irrigation, power generation and water supply.

Farakka Barrage Project

The Farakka Barrage Project is designed to sub serve the need for preservation and maintenance of the Calcutta Port by improving the regime and navigability of the Bhagirathi- Hooghly River System. The Bhagirathi, the feeder canal and the navigation lock at the Farakka Barrage form part of the Haldi-Allahabad Inland Waterway for which an act has been passed.

Irrigation:

- ✓ Presently, irrigated land covers about 277 million hectares. With the large population growth expected for the next decades, irrigation must be expanded to increase the food capacity production.
- ✓ It is estimated that 80% of additional food production by the year 2025 will need to come from irrigated land. Even with the widespread measures to conserve water by improvements in irrigation technology, the construction of more reservoir projects will be required.

Hydropower:

- ✓ Hydroelectric power plants generally range in size from several hundred kilowatts to several hundred megawatts, but a few enormous plants have capacities near 10,000 megawatts in order to supply electricity to millions of people. World hydroelectric power plants have a combined capacity of 675,000 megawatts that produces over 2.3 trillion kilowatt-hours of electricity each year; supplying 24 percent of the world's electricity.
- ✓ In many countries, hydroelectric power provides nearly all of the electrical power. Electricity generated from dams is by very far the largest renewable energy source in the world. More than 90% of the world's renewable electricity comes from dams.
- ✓ Hydropower also offers unique possibilities to manage the power network by its ability to quickly respond to peak demands. Pumping-storage plants, using power produced during the night, while the demand is low, is used to pump water up to the higher reservoir. That water is then used during the peak demand period to produce electricity.
- ✓ Water supply for domestic and industrial use: It has been stressed how essential water is for our civilization. Properly planned, designed and constructed and maintained dams to store water contribute significantly toward fulfilling our water supply requirements. Dams and reservoirs are needed to store water and then provide more consistent supplies during shortages.

Inland navigation:

- ✓ Natural river conditions, such as changes in the flow rate and river level, ice and changing river channels due to erosion and sedimentation, create major problems and obstacles for inland navigation.
- ✓ The advantages of inland navigation are the large load carrying capacity of each barge, the ability to handle cargo with large-dimensions and fuel savings. Enhanced inland navigation is a result of comprehensive basin planning and development utilizing dams, locks and reservoirs which are regulated to provide a vital role in realizing regional and national economic benefits.

- ✓ In addition to the economic benefits, a river that has been developed with dams and reservoirs for navigation may also provide additional benefits of flood control, reduced erosion, stabilized groundwater levels throughout the system and recreation.

Flood control:

- ✓ Dams and reservoirs can be effectively used to regulate river levels and flooding downstream of the dam by temporarily storing the flood volume and releasing it later. The most effective method of flood control is accomplished by an integrated water management plan for regulating the storage and discharges of each of the main dams located in a river basin.
- ✓ Each dam is operated by a specific water control plan for routing floods through the basin without damage. This means lowering of the reservoir level to create more storage before the rainy season. This strategy eliminates flooding. The number of dams and their water control management plans are established by comprehensive planning for economic development and with public involvement.

- **What is forest product:-**

- ✓ A forest product is any material derived from forestry for direct consumption or commercial use, such as lumber, paper, or forage for livestock. Wood, by far the dominant product of forests, is used for many purposes, such as wood fuel (e.g. in form of firewood or charcoal) or the finished structural materials used for the construction of buildings, or as a raw material, in the form of wood pulp, that is used in the production of paper.
- ✓ All other non-wood products derived from forest resources, comprising a broad variety of other forest products, are collectively described as non-timber forest products (NTFP).
- ✓ Following are some of the **forest(wood) products**:
 - 1) **Timber**: The Odisha Forest Development Corporation (OFDC) trades timber in round and sawn forms, in different dimensions, from several depots. Round timbers are sold monthly from each depot, through general auction.
 - 2) **Sandalwood**: The sandalwood tree is found in southern Indian forests, i.e. in Kerala, Tamil Nadu, Karnataka, etc.
 - 3) **Plywood**: The plywood industry at Kuikeda near Saintala of Bolangir district, Odisha, was incorporated during 1983, and started commercial production during the year, 1986-87; it operated until 1992-93.
- ✓ **Non-wood forest produce**: Non-timber forest product (NTFP) refers to all biological materials other than timber extracted from natural forests for human and animal use.
 - 1) **Kendu leaves**: Orissa is the third largest producer of Kendu leaf in India. The uniqueness of kendu leaf in Orissa is because of its specification of Color, Texture, Size and Body condition of the leaf.
 - 2) **Tendu Patta (Leaf) Collection**

- 3) **Bamboo:** The collection and marketing of Bamboo from the natural forest is done either by OFDC or through the RMP (Raw Material Procurer) as per the decision of the Government to regulate the collection and trade of Bamboo.
- 4) **Sal seed:** Sal seed is a nationalized product since 1973 and is one of the important Produce obtained from Sal (Shorea robusta) tree, which is predominantly available in Orissa.
- 5) **Honey:** OFDC is involved in collection, processing and trading of honey from natural forest with an assurance of pure and genuine in quality.
- 6) **Medicinal plants:** With the financial aid of National Medicinal Plants Board, Government of India, 16 projects for promotional activities are currently running in Orissa.
- 7) **Rubber:** OFDC is having rubber plantation and processing unit in Baripada & Bhubaneswar zone, since 2003. OFDC is extracting the rubber from the matured trees and marketing it.
- 8) **Pickle & squash:** OFDC is manufacturing and marketing high quality, delicious pickles such as Mango Pickle, Mixed Pickle – free from preservatives.
- 9) **Cashew & spice:** OFDC Ltd. have raised cashew plantation over an area of 18704.99 ha. from 1978-79 to 1992-93 in Bhubaneswar and Berhampur Division. Out of which pure cashew plantation over an area of 11,053.99 ha.

- **Environmental bioethics**

- ✓ It is an undertaking that seeks just social arrangements that can promote human well-being and, at the same time, preserve the natural environment, both now and in the future. The core of the environmental bioethics portfolio consists of three basic issues: technology, toxics, and consumption.
- ✓ Environmental hazards have negative human health impacts, but the role of bioethics is not to achieve the goods of health, but to identify, articulate, and contribute to the maintenance of ethical goods: fairness, equity, rights, dignity, and so forth.
- ✓ Climate change will have adverse public health and infrastructure impacts globally and increase health inequities between nations and groups. Bioethics must reorient itself according to its original environmentally inclusive aspirations in order to be able to address issues that have both human health and ecosystem implications which either cannot or should not be addressed in isolation.
- ✓ Environmental ethics is a branch of ethics that studies the relation of human beings and the environment and how ethics play a role in this. Environmental ethics believe that humans are a part of society as well as other living creatures, which includes plants and animals.
- ✓ Therefore, it is essential that every human being respected and honor this and use morals and ethics when dealing with these creatures.
- ✓ Every time that a tree is cut down to make a home or other resources are used, we are using natural resources that are becoming more and more difficult to find. It is essential that you do your part to keep the environment protected and free from danger.
- ✓ With the rapid increase in the world's population, the consumption of natural resources has increased several times. This has degraded our planet's ability to provide the services we humans need. The consumption of resources is going at a faster rate than they can naturally replenish.

- **Types of Environmental Ethics**

The types include:

- ✓ Social ecology, which is the study of human beings and their relation to their environment.
- ✓ Deep ecology promotes that all beings have an intrinsic value.
- ✓ Eco feminism is a branch of feminism that helps us look at earth as a woman so that we can respect it in a better way.
- ✓ The **development ethic** : Development in any sector is inevitable. . But the development should not crop up at the cost of environmental failure. This philosophy is strengthened by the idea that, “if it can be done, it should be done.”
- ✓ The **preservation ethic** considers nature special in itself. Some preservationists have an almost religious outlook regarding nature. They believe that nature is beautiful place to live in and it should be maintained for feeding, breeding, enjoyment and peace. On the other hand scientific outlook argue that the human species depends on and has much to learn from nature. Rare and endangered species and ecosystems, as well as the more common ones, must be preserved because of their known or assumed long-range, practical utility.
- ✓ The third **environmental ethic** is referred to as the conservation ethic, It recognizes the desirability of decent living standards, but it works towards a balance of resource use and resource availability.

- **Biodiversity and its Role:**

- ✓ Biodiversity is a state of variety of differences among the biological organisms of a region.
- ✓ Biodiversity is important to humans for many reasons. Biodiversity is also considered by many to have intrinsic value—that is, each species has a value and a right to exist, whether or not it is known to have value to humans.
- ✓ **Economic**—biodiversity provides humans with raw materials for consumption and production. Many livelihoods, such as those of farmers, fishers and timber workers, are dependent on biodiversity.
- ✓ **Ecological** life support—biodiversity provides functioning ecosystems that supply oxygen, clean air and water, pollination of plants, pest control, wastewater treatment and many ecosystem services.
- ✓ **Recreation**—many recreational pursuits rely on our unique biodiversity, such as bird watching, hiking, camping and fishing. Our tourism industry also depends on biodiversity.
- ✓ **Cultural**—the Australian culture is closely connected to biodiversity through the expression of identity, through spirituality and through aesthetic appreciation. Indigenous Australians have strong connections and obligations to biodiversity arising from spiritual beliefs about animals and plants.
- ✓ **Scientific**—biodiversity represents a wealth of systematic ecological data that help us to understand the natural world and its origins.
- ✓ Biodiversity is especially important to the medical and pharmaceutical industries. Scientists have discovered many chemicals in rain forest plants that are now used in helpful drugs. One of the most popular and safe pain relievers, aspirin, was originally made from the bark of willow trees.

- ✓ Medicines that treat some forms of cancer have been made from the rosy periwinkle, a flower that grows on the African island of Madagascar. Scientists have studied only a small percentage of rain forest species in their search for cures. But every year, thousands of species go extinct, or die out entirely, before scientists can determine whether they might be useful in medicines.

- **Bio-Ethics:**

- ✓ Environmental bioethics is an undertaking that seeks just social arrangements that can promote human well-being and, at the same time, preserve the natural environment, both now and in the future.
- ✓ The core of the environmental bioethics portfolio consists of **three basic issues**: technology, toxics, and consumption. Environmental hazards have negative human health impacts, but the role of bioethics is not to achieve the goods of health, but to identify, articulate, and contribute to the maintenance of ethical goods: fairness, equity, rights, dignity, and so forth.
- ✓ Taking justice seriously as a bioethical good will require attending to the health equity implications of our environmental future. Climate change will have adverse public health and infrastructure impacts globally and increase health inequities between nations and groups.

- **Waste Management and trade:**

- ✓ Waste is defined as unwanted and unusable materials and is regarded as a substance which is of no use. Waste that we see in our surroundings is also known as garbage. Garbage is mainly considered as a solid waste that includes wastes from our houses (domestic waste), wastes from schools, offices, etc (municipal wastes) and wastes from industries and factories (industrial wastes).
- ✓ The process of waste management involves treating solid and liquid waste. During the treatment, it also offers a variety of solutions for recycling items that aren't categorized as trash.
- ✓ Recycling of waste product is very important as this process helps in processing waste or used products into useful or new products. Recycling helps in controlling air, water, and land pollution. It also uses less energy. There are a number of items that can be recycled like paper, plastic, glass, etc. Recycling helps in conserving natural resources and also helps in conserving energy. Recycling helps in protecting the environment as it helps in reducing air, water, and soil pollution.
- ✓ The global waste trade is the international trade of waste between countries for further treatment, disposal, or recycling. Toxic or hazardous wastes are often imported by developing countries from developed countries.
- ✓ Most of the world's trade with waste goes from one developed country to another. But a considerable amount of waste also goes from developed countries to countries in the third

world. There are three ways for the waste-importing country to deal with waste; landfill, incineration or recycling.

- ✓ In many household and production processes, unwanted by-products are generated and these can in themselves be tradable commodities, such as waste-paper, organic material, electronic waste and so on.
- ✓ The waste contains toxic metals that are harmful for the people handling it and poison the surrounding environment.
- ✓ A waste disposal service can cause negative externalities, for instance, when a waste importing country uses the waste as landfill and toxic substances leak into a nearby river. In this case a free market will cause overproduction in waste disposal services, because the externality cost will not be included in the cost of production.
- ✓ e-waste going to China it is clear that it is cheaper to recycle e-waste in China than in the US for instance. Waste and especially e-waste contains toxic substances that can create negative externalities.

Solid Waste Management

Environmental problems also include solid waste disposal. At all levels of development human beings produce domestic wastes. These comprises of kitchen wastes, ashes from fires, broken utensils and worn-out clothing. The industrial revolution leads to the concentration of people in urban areas with very high population density. This resulted in addition of new sources of wastes from shops, institutions and factories. In developed countries services for the regular removal of domestic and trade wastes have been in operation for last many years.

Many changes have taken place in our society. The character of the wastes has altered with rising living standards, changes in retail distribution methods and fuel technology. Grave environmental concerns have come up with rise in construction of new buildings, supermarkets, and industrial wastes of many kinds. In the industrialized countries, therefore, basic health and environmental problems have been solved in the storage and collection of solid wastes, although major problems remain in regard to resource recovery and disposal. The technology of wastes handling is now highly developed. The substantial sectors of industry are engaged in the production of equipment with regard to removal of wastes. Many institutions give technical training and support. However developing nations like India are facing the problems of urbanization with high population densities. The developing countries are aware of the importance of avoiding the environmental pollution. The quality of urban environment is a matter of growing concern and the importance of solid wastes management is increasingly being recognized.

Sources and Characteristics

Solid wastes generally refer to describe non-liquid waste materials arising from domestic, trade, commercial, industrial, agriculture and mining activities and from the public services. Disposal of sludge's (liquid waste) of some kind fall within the scope of solid waste management. These arise primarily from industrial sources and from sewage treatment plants. Solid wastes comprise countless different materials; dust, food wastes, packaging in the form of paper, metals, plastics or glass, discarded clothing and furnishing, garden wastes

and hazardous and radioactive wastes. The method and capacity of storage, the correct type of collection vehicle, the optimum size of crew and the frequency of collection depend mainly on volume and density. Just as solid wastes comprise a vast number of materials, they arise from a multitude of separate sources as well as many kilometers of streets upon which solid wastes accumulate. Thus, the four main aspects of solid wastes management are: (i) storage at or near the point of generation, (ii) collection, (iii) street cleansing, (iv) disposal.

The main constituents of solid wastes are similar throughout the world, but the proportions vary widely. As personal income rises, paper increases, kitchen wastes decline, metals and glass increase, total weight generated rises and the density of the wastes declines. Clearly, the amount of work involved in refuse collection depends upon the weight and volume of wastes generated and the number of collection points from which the wastes have to be removed.

Health and environmental implications

Improper handling of solid wastes results in increased potential risks to health and to the environment both. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from skin contact with wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. More serious, however, and often unrecognized, is the transfer of pollution to water, which occurs when the leachate from a refuse dump enters surface water or wastes, either in the open air, or in plants that lack effective treatment facilities for the gaseous effluents. Traffic accidents can result from wastes accumulated and dispersed on to streets and roads. They have caused death and injury to people in the surrounding areas. There also persists the specific danger of the concentration of heavy metals in the food chain. These metals can be taken up by the plants growing on land on which sludge has been deposited, creating risks to the animals which graze and the humans who consume these animals.

Economic implications

Labour and transport absorb the major part of the operating cost of solid wastes management services. The level of mechanization that should be adopted for solid wastes management systems relates directly to the cost of labour, as compared to that of plant and energy. There is not much variation, worldwide, in energy or mechanical plant costs, but there is wide variation in the range of labour costs. Thus, there are no universally applicable solid wastes management systems. Every country must evolve indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates, equipment, manufacturing capacity, energy costs etc. It is necessary to deploy a complete set of technical skills, which derive from several professional disciplines. These include civil and mechanical engineering, chemical engineering, transport organization, land use planning and economics.

Refuse Collection

A refuse collection service requires vehicles and labour. For their efficient development, three components are basic:

(1) Travel to and from the work area,

- (2) The collection process, and
- (3) The delivery process.

The use of large, widely spaced communal storage sites is usually a failure because the demand placed on the householder goes beyond his willingness to cooperate. Communal storage points should, therefore, be at frequent intervals, Madras and Bangalore provide fixed concrete containers. They are fairly successful because they place reasonable and acceptable duty on the residents, thus very little domestic waste is thrown in the street. In another system of block collection, a collection vehicle travels a regular route at prescribed intervals, usually every two days or every three days, and it stops at every street intersection, where a bell is rung. At this signal the residents of all the streets leading from that intersection bring their wastes containers to the vehicle and hand them to the crew to be emptied. A crew of one or two men is adequate in number, as they do not need to leave the vehicle.

Sanitary Landfill Disposal

Land disposal (burying of wastes) is the only approved method of disposal, which is performed at a single site. Incineration, composting, and salvage are either a form of refuse handling or processing. They are not complete methods of disposal, and they require disposal of residue. Sanitary landfill can be defined as the use of solid wastes for land-reclamation, a typical example being the restoration, by filling to the original level of man made surface dereliction such as a disused surface, mineral excavation. Solid wastes may also be used to improve natural features by raising the level of low-lying land to enable it to be used or cultivation or industrial development. Thus, sanitary land filling has two essential features, which differentiate it from crude dumping:

- (i) Only sites that will be improved not degraded, by a change of level are selected.
- (ii) Simple engineering techniques are used to control the manner in which the wastes are deposited, so that dangers to public health and the environment are avoided.

Unfortunately most of the world's wastes are disposed off by uncontrolled dumping which blights the land for any future use and causes serious risks of water pollution and vector breeding. Very few cities operate sanitary land filling to standards, which totally control health and environmental dangers; most of those that do are in the industrialized countries.

Control of Hazards

- (i) Control over pathogens is dependent upon a rigorous policy of covering the wastes soon after deposit. This serves both to isolate the wastes and to retain the heat, which is quickly generated during aerobic decomposition.
- (ii) The main source of insects will be the eggs of flies. Which have been deposited in the wastes before they arrive at the site. Most of these will be buried deep in the wastes and will succumb to the temperature increase.
- (iii) Fire at a sanitary landfill can arise from innumerable causes, hot ashes in a vehicle delivering wastes: a cigarette thrown by a worker; the sun's ray through a fragment of glass on the surface. With some kinds of wastes the consequence of fire may be very serious and underground fires have been known that ultimately caused the

collapse of the surface into voids caused by the fire.

(iv) The pollution of static water, ditches, river or the sea occurs when a sanitary landfill adjoins a body of water. The normal source of the leachate causing this pollution is rain falling on the surface.

of volume reduction except for Pyrolysis. Unlike a sanitary landfill, incineration of solid wastes can be performed on the premises of apartments, supermarkets, departments' stores, and similar establishments.

FMS