

Subject-Environment Studies and Disaster Management

ECE-2nd semester

ECOLOGY

Ecology is the study of interactions between living things and the environment. An ecosystem is the combination of living things, such as plants, animals and microscopic organisms, plus environmental factors such as temperature, rain and sun light and ecology studies all of these aspects of an ecosystem. As a science, ecology is a broad field and includes a number of different sciences such as biology, physics, chemistry and geology.

Organisms and the environment both affect each other. For example, a plant is affected by rain and sun light but environment beneath the plant is influenced by the plant because it reduces the amount of light, drops leaves, reduces the temperature and so on. Additionally, living things influence each other through competition, predation and other relationships. Environmental factors are often referred to as abiotic factors and relationships between living things are often called biotic factors.

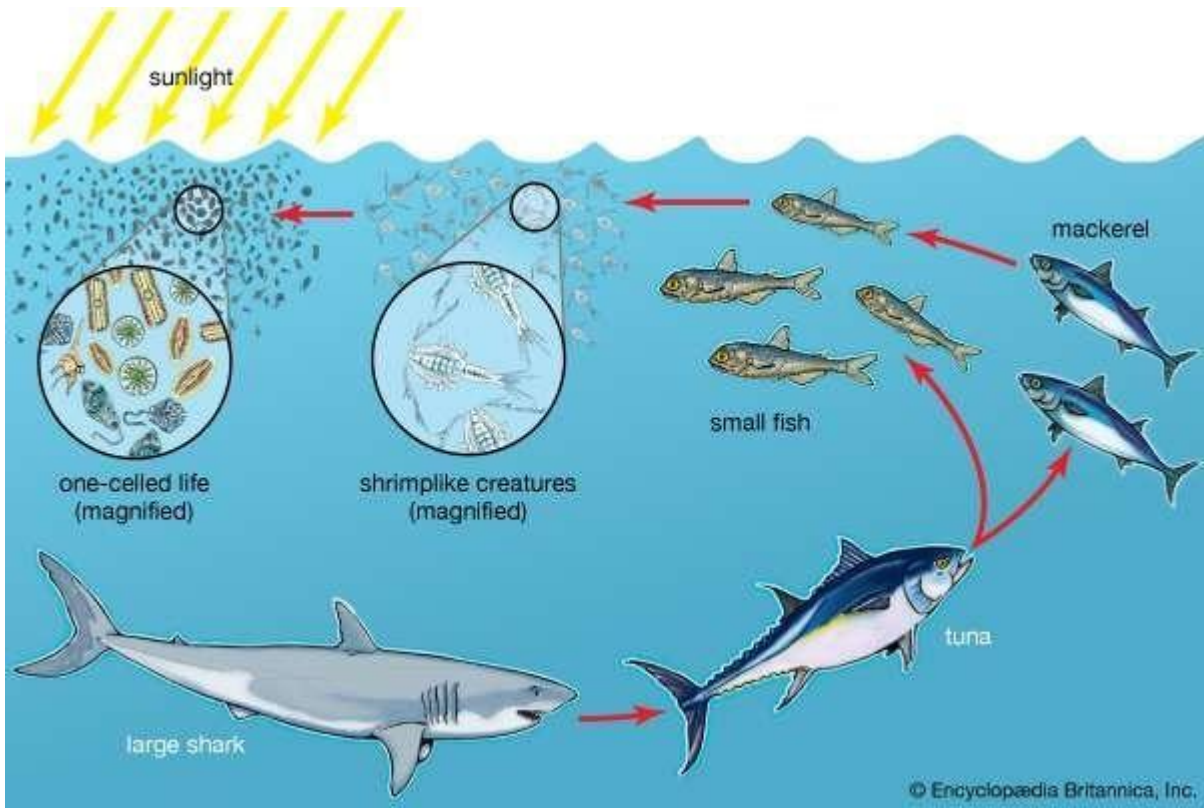
ECOSYSTEM

Ecosystem can be categorized into its abiotic constituents, including minerals, climate, soil, water, sunlight, and all other nonliving elements, and its biotic constituents, consisting of all its living members. Linking these constituents together are two major forces: the flow of energy through the ecosystem, and the cycling of nutrients within the ecosystem.

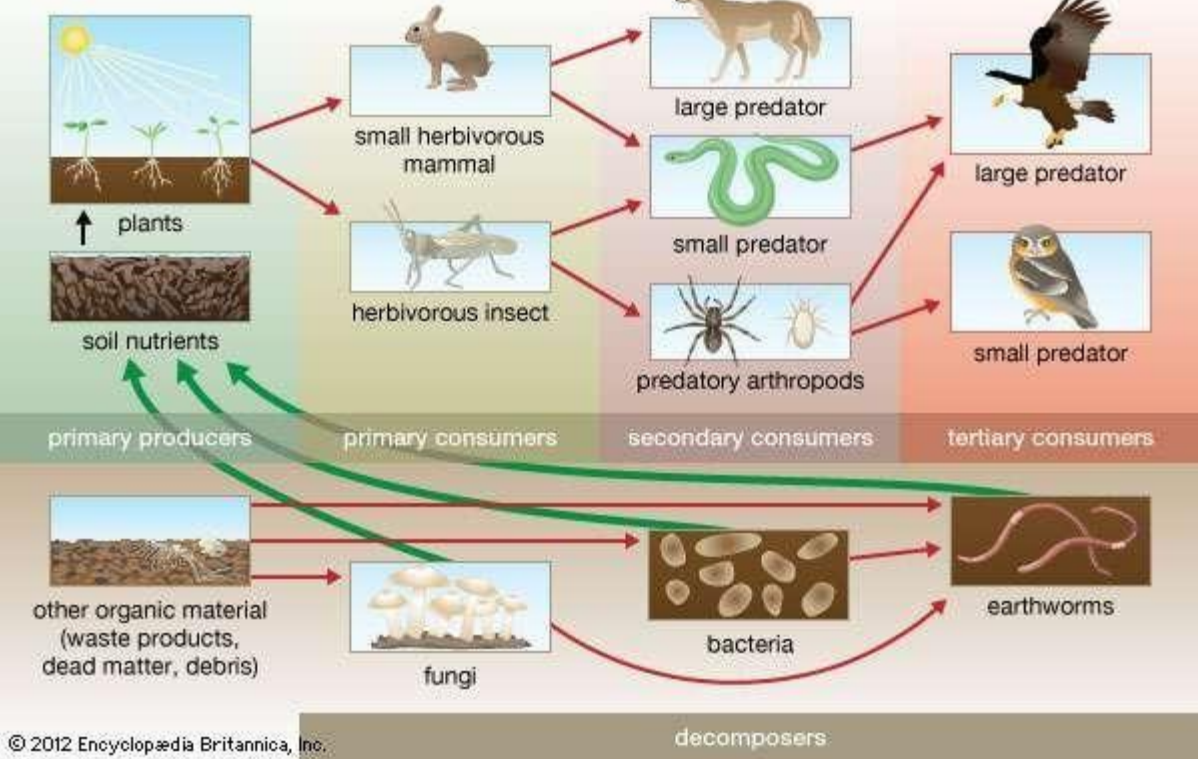
The fundamental source of energy in almost all ecosystems is radiant energy from the Sun. The energy of sunlight is used by the ecosystem's autotrophic, or self-sustaining, organisms. Consisting largely of green vegetation, these organisms are capable of photosynthesis—i.e., they can use the energy of sunlight to convert carbon dioxide and water into simple, energy-rich carbohydrates. The autotrophs use the energy stored within the simple carbohydrates to

produce the more complex organic compounds, such as proteins, lipids, and starches, that maintain the organisms' life processes. The autotrophic segment of the ecosystem is commonly referred to as the producer level.

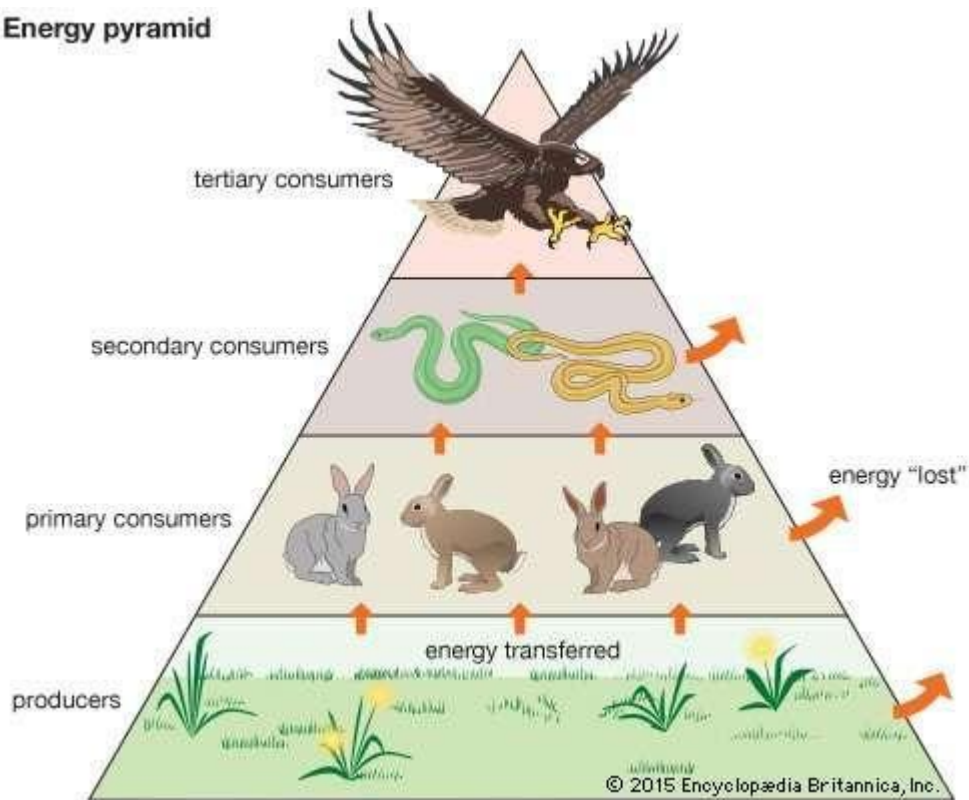
Organic matter generated by autotrophs directly or indirectly sustains heterotrophic organisms. Heterotrophs are the consumers of the ecosystem; they cannot make their own food. They use, rearrange, and ultimately decompose the complex organic materials built up by the autotrophs. All animals and fungi are heterotrophs, as are most bacteria and many other microorganisms. The ecosystem: the producer level, composed of those organisms that make their own food; the primary consumer level, composed of those organisms that feed on producers; the secondary consumer level, composed of those organisms that feed on primary consumers; and so on. The movement of organic matter and energy from the producer level through various consumer levels makes up a food chain. For example, a typical food chain in a grassland might be grass (producer) → mouse (primary consumer) → snake (secondary consumer) → hawk (tertiary consumer). Actually, in many cases the food chains of the ecosystem overlap and interconnect, forming what ecologists call a food web. The final link in all food chains is made up of decomposers, those heterotrophs that break down dead organisms and organic wastes. A food chain in which the primary consumer feeds on living plants is called a grazing pathway; that in which the primary consumer feeds on dead plant matter is known as a detritus pathway. Both pathways are important in accounting for the energy budget of the ecosystem.



Terrestrial food chain



Energy pyramid



A food chain in the ocean begins with tiny one-celled organisms called diatoms. They make their own food from sunlight. Shrimplike creatures eat the diatoms. Small fish eat the shrimplike creatures, and bigger fish eat the small **terrestrial food chain** The terrestrial food chain featuring producers, consumers, and decomposers.

Energy Pyramid

An energy pyramid is a model that shows the flow of energy from one trophic level to the next along a food chain. The pyramid base contains producers—organisms that make their own food from inorganic substances. All other organisms in the pyramid are consumers. The consumers at each level feed on organisms from the level below and are themselves consumed by organisms at the level above. Most of the food energy that enters a trophic level is “lost” as heat when it is used by organisms to power the normal activities of life.

SUSTAINABLE DEVELOPMENT

Increasing recognition that the overall goals of environmental conservation and economic development are not conflicting but can be mutually reinforcing, has prompted calls for

'Environmentally sustainable' economic development. Although there are difficulties in defining sustainable development in an analytically rigorous way, there is still a need to evolve a concept of sustainability that both distinguishes it from other post-war meanings of development and is useful for practical analysis and policymaking.

Nonrenewable and Renewable Energy Resources

Renewable Resources

Renewable resources are resources that are replenished by the environment over relatively short periods of time. This type of resource is much more desirable to use because often a resource renews so fast that it will have regenerated by the time you've used it up.

Think of this like the ice cube maker in your refrigerator. As you take some ice out, more ice gets made. If you take a lot of ice out, it takes a little more time to refill the bin but not a very long time at all. Even if you completely emptied the entire ice cube bin, it would probably only take a few hours to 'renew' and refill that ice bin for you. Renewable resources in the natural environment work the same way.

Solar energy is one such resource because the sun shines all the time. Imagine trying to harness all of the sun's energy before it ran out! Wind energy is another renewable resource. You can't stop the wind from blowing any more than you can stop the sun from shining, which makes it easy to 'renew.'

Any plants that are grown for use in food and manufactured products are also renewable resources. Trees used for timber, cotton used for clothes, and food crops, such as corn and wheat, can all be replanted and regrown after the harvest is collected.

Animals are also considered a renewable resource because, like plants, you can breed them to make more. Livestock, like cows, pigs and chickens, all fall into this category. Fish are also considered renewable, but this one is a bit trickier because even though some fish are actually farmed for production, much of what we eat comes from wild stocks in lakes and oceans. These wild populations are in a delicate balance, and if that balance is upset by overfishing, that population may die out.

Water is also sometimes considered a renewable resource. You can't really 'use up' water, but you also can't make more of it. There is a limited supply of water on Earth, and it cycles through the planet in various forms - as a liquid (our oceans), a solid (our polar ice caps and glaciers) and a gas (as clouds and water vapor).

Liquid water can be used to generate hydroelectric power, which we get from water flowing through dams. This is considered a renewable resource because we don't actually take the water out of the system to get electricity. Like sunshine and wind, we simply sit back and let the resource do all the work!

Geothermal energy is a renewable resource that provides heat from the earth - 'geo' means 'earth' and 'thermal' means 'heat.' You know all of those volcanoes on Earth that spew hot lava when they erupt? That lava has got to come from somewhere, right? It's actually sitting underneath the earth's surface as incredibly hot rock and magma.

Non-renewable resource

non-renewable resource (also called a finite resource) is a resource that does not renew itself at a sufficient rate for sustainable economic extraction in meaningful human time-frames. An example is carbon-based, organically-derived fuel. The original organic material, with the aid of heat and pressure, becomes a fuel such as oil or gas. Earth minerals and metal ores, fossil fuels (coal, petroleum, natural gas) and groundwater in certain aquifers are all considered non-renewable resources, though individual elements are almost always conserved.

In contrast, resources such as timber (when harvested sustainably) and wind (used to power energy conversion systems) are considered renewable resources, largely because their localized replenishment can occur within time frames meaningful to humans

Earth minerals and metal ore

Earth minerals and metal ores are examples of non-renewable resources. The metals themselves are present in vast amounts in Earth's crust, and their extraction by humans only occurs where they are concentrated by natural geological processes (such as heat, pressure, organic activity,

weathering and other processes) enough to become economically viable to extract. These processes generally take from tens of thousands to millions of years, through plate tectonics, tectonic subsidence and crustal recycling.

The localized deposits of metal ores near the surface which can be extracted economically by humans are non-renewable in human time-frames. There are certain rare earth minerals and elements that are more scarce and exhaustible than others. These are in high demand in manufacturing, particularly for the electronics industry.

Most metal ores are considered vastly greater in supply to fossil fuels, because metal ores are formed by crustal-scale processes which make up a much larger portion of the Earth's near-surface environment, than those that form fossil fuels which are limited to areas where carbon-based life forms flourish, die, and are quickly buried.

Fossil fuels

Natural resources such as coal, petroleum (crude oil) and natural gas take thousands of years to form naturally and cannot be replaced as fast as they are being consumed. Eventually it is considered that fossil-based resources will become too costly to harvest and humanity will need to shift its reliance to other sources of energy such as solar or wind power, see renewable energy.

An alternative hypothesis is that carbon based fuel is virtually inexhaustible in human terms, if one includes all sources of carbon-based energy such as methane hydrates on the sea floor, which are vastly greater than all other carbon based fossil fuel resources combined.^[1] These sources of carbon are also considered non-renewable, although their rate of formation/replenishment on the sea floor is not known. However, their extraction at economically viable costs and rates has yet to be determined.

At present, the main energy source used by humans is non-renewable fossil fuels. Since the dawn of internal combustion engine technologies in the 19th century, petroleum and other fossil fuels have remained in continual demand. As a result, conventional infrastructure and transport systems, which are fitted to combustion engines,

remain prominent throughout the globe. The continual use of fossil fuels at the current rate is believed to increase global warming and cause more severe climate change.^[2]

What is Air Pollution?

Pollution is now a common place term, that our ears are attuned to. We hear about the various forms of pollution and read about it through the mass media. Air pollution is one such form that refers to the contamination of the air, irrespective of indoors or outside. A physical, biological or chemical alteration to the air in the atmosphere can be termed as pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for plants, animals and humans to survive as the air becomes dirty.

Air pollution can further be classified into two sections- Visible air pollution and invisible air pollution. Another way of looking at Air pollution could be any substance that holds the potential to hinder the atmosphere or the well-being of the living beings surviving in it. The sustainment of all things living is due to a combination of gases that collectively form the atmosphere; the imbalance caused by the increase or decrease of The Ozone layer considered crucial for the existence of the ecosystems on the planet is depleting due to increased pollution. Global warming, a direct result of the increased imbalance of gases in the atmosphere has come to be known as the biggest threat and challenge that the contemporary world has to overcome in a bid for survival.

Types of Pollutants

In order to understand the causes of Air pollution, several divisions can be made. **Primarily air pollutants** can be caused by primary sources or secondary sources. The pollutants that are a

direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulfur-dioxide emitted from factories

Secondary pollutants are the ones that are caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

Causes of Air pollution

1. Burning of Fossil Fuels: Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one the major cause of air pollution. Pollution emitting from vehicles including trucks, jeeps, cars, trains, airplanes cause immense amount of pollution. We rely on them to fulfill our daily basic needs of transportation. But, there overuse is killing our environment as dangerous gases are polluting the environment. Carbon Monoxide caused by improper or incomplete combustion and generally emitted from vehicles is another major pollutant along with Nitrogen Oxides, that is produced from both natural and man made processes.

2. Agricultural activities: Ammonia is a very common by product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities has grown quite a lot. They emit harmful chemicals into the air and can also cause water pollution.

3. Exhaust from factories and industries: Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Manufacturing industries can be found at every corner of the earth and there is no area that has not been affected by it. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.

4. Mining operations: Mining is a process wherein minerals below the earth are extracted using large equipment. During the process dust and chemicals are released in the air causing

massive air pollution. This is one of the reasons which is responsible for the deteriorating health conditions of workers and nearby residents.

5. Indoor air pollution: Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution. Have you ever noticed that once you paint walls of your house, it creates some sort of smell which makes it literally impossible for you to breathe.

Suspended particulate matter popular by its acronym SPM, is another cause of pollution. Referring to the particles afloat in the air, SPM is usually caused by dust, combustion etc.

Effects of Air pollution

1. Respiratory and heart problems: The effects of Air pollution are alarming. They are known to create several respiratory and heart conditions along with Cancer, among other threats to the body. Several millions are known to have died due to direct or indirect effects of Air pollution. Children in areas exposed to air pollutants are said to commonly suffer from pneumonia and asthma.

2. Global warming: Another direct effect is the immediate alterations that the world is witnessing due to Global warming. With increased temperatures worldwide, increase in sea levels and melting of ice from colder regions and icebergs, displacement and loss of habitat have already signaled an impending disaster if actions for preservation and normalization aren't undertaken soon.

3. Acid Rain: Harmful gases like nitrogen oxides and sulfur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combine with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to human, animals and crops.

4. Eutrophication: Eutrophication is a condition where high amount of nitrogen present in some pollutants gets developed on sea's surface and turns itself into algae and adversely

affect fish, plants and animal species. The green colored algae that is present on lakes and ponds is due to presence of this chemical only.

5. Effect on Wildlife: Just like humans, animals also face some devastating effects of air pollution. Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat. The toxic pollutants deposit over the surface of the water and can also affect sea animal

Harmful Effects of Air Pollution

1. Air pollution affects respiratory system causing breathing difficulties and diseases such as bronchitis, asthma, lung cancer, tuberculosis and pneumonia.
2. It affects the central nervous system causing carbon monoxide poisoning. CO has more affinity for hemoglobin than oxygen and thus forms a stable compound carboxyhemoglobin, which is poisonous and causes suffocation and death.
3. It causes depletion of ozone layer due to which ultraviolet radiations can reach the earth and cause skin cancer, damage to eyes and immune system.
4. It causes acid rain which damages crop plants, trees, buildings, monuments, statues and metal structures and also makes the soil acidic.
5. It causes greenhouse effect and global warming which leads to excessive heating of earth's atmosphere, further leading to weather variability and rise in sea level. The increased temperature may cause melting of ice caps and glaciers, resulting in floods.
6. Air pollution from certain metals, pesticides and fungicides causes serious ailments.
 - Lead pollution causes anemia, brain damage, convulsions and death.
 - Certain metals cause problem in kidney, liver, circulatory system and nervous system.
 - Fungicides cause nerve damage and death.

- Pesticides like DDT(Dichlorodiphenyltrichloroethane) which are toxic enter into our food chain and gets accumulated in the body causing kidney disorders and problems of brain and circulatory system.

Prevention And Control of Air Pollution

Different techniques are used for controlling air pollution caused by 'gaseous pollutants' and that caused by 'particulate pollutants'.

- **Methods of controlling gaseous pollutants**-The air pollution caused by gaseous pollutants like hydrocarbons, Sulphur dioxide, ammonia, carbon monoxide, etc. can be controlled by using three different methods-Combustion, Absorption and Adsorption.
 1. **Combustion**-This technique is applied when the pollutants are organic gases or vapors. The organic air pollutants are subjected to 'flame combustion or catalytic combustion' when they are converted to less harmful product carbon dioxide and a harmless product water.
 2. **Absorption**-In this method, the polluted air containing gaseous pollutants is passed through a scrubber containing a suitable liquid absorbent. The liquid absorbs the harmful gaseous pollutants present in air.
 3. **Adsorption**-In this method, the polluted air is passed through porous solid adsorbents kept in suitable containers. The gaseous pollutants are adsorbed at the surface of the porous solid and clean air passes through.
- **Methods of controlling particulate emissions**-The air pollution caused by particulate matter like dust, soot, ash, etc. can be controlled by using fabric filters, wet scrubbers, electrostatic precipitators and certain mechanical devices.
 1. **Mechanical Devices**-It works on the basis of following:
 - **Gravity**-In this process, the particulate settles down by the action of gravitational force and get removed.
 - **Sudden change in the direction of air flow**-It brings about separation of particles due to greater momentum.

2. **Fabric Filters**-The particulate matter is passed through a porous medium made of woven or filled fabrics.

- The particulate present in the polluted air are filtered and gets collected in the fabric filters, while the gases are discharged.
- The process of controlling air pollution by using fabric filters is called 'bag filtration'.

3. **Wet Scrubbers**-They are used to trap SO_2 , NH_3 and metal fumes by passing the fumes through water.

4. **Electrostatic Precipitators**-When the polluted air containing particulate pollutants is passed through an electrostatic precipitator, it induces electric charge on the particles and then the aerosol particles get precipitated on the electrodes.

Some other methods of controlling Air Pollution:

1. Tall chimneys should be installed in factories.
2. Better designed equipment and smokeless fuels should be used in homes and industries.
3. Renewable and non-polluting sources of energy like solar energy, wind energy, etc should be used.
4. Automobiles should be properly maintained and adhere to emission control standards.
5. More trees should be planted along roadsides and houses.

Effective Methods to Control Air Pollution

Some of the effective methods to Control Air Pollution are as follows: (a) Source Correction Methods (b) Pollution Control equipment (c) Diffusion of pollutant in air (d) Vegetation (e) Zoning.

(a) Source Correction Methods:

Industries make a major contribution towards causing air pollution. Formation of pollutants can be prevented and their emission can be minimized at the source itself.

By carefully investigating the early stages of design and development in industrial processes e.g., those methods which have minimum air pollution potential can be selected to accomplish air-pollution control at source itself.

These source correction methods are:

(i) Substitution of raw materials:

If the use of a particular raw material results in air pollution, then it should be substituted by another purer grade raw material which reduces the formation of pollutants. Thus,

(a) Low Sulphur fuel which has less pollution potential can be used as an alternative to high Sulphur fuels, and,

(b) Comparatively more refined liquid petroleum gas (LPG) or liquefied natural gas (LNG) can be used instead of traditional high contaminant fuels such as coal.

(ii) Process Modification:

The existing process may be changed by using modified techniques to control emission at source. For example,

(a) If coal is washed before pulverization, then fly-ash emissions are considerably reduced.

(b) If air intake of boiler furnace is adjusted, then excess Fly-ash emissions at power plants can be reduced.

(iii) Modification of Existing Equipment:

Air pollution can be considerably minimized by making suitable modifications in the existing equipment:

(a) For example, smoke, carbon-monoxide and fumes can be reduced if open hearth furnaces are replaced with controlled basic oxygen furnaces or electric furnaces.

(b) In petroleum refineries, loss of hydrocarbon vapors from storage tanks due to evaporation, temperature changes or displacement during filling etc. can be reduced by designing the storage tanks with floating roof covers.

(c) Pressurizing the storage tanks in the above case can also give similar results.

(iv) Maintenance of Equipment:

An appreciable amount of pollution is caused due to poor maintenance of the equipment which includes the leakage around ducts, pipes, valves and pumps etc. Emission of pollutants due to negligence can be minimized by a routine checkup of the seals and gaskets.

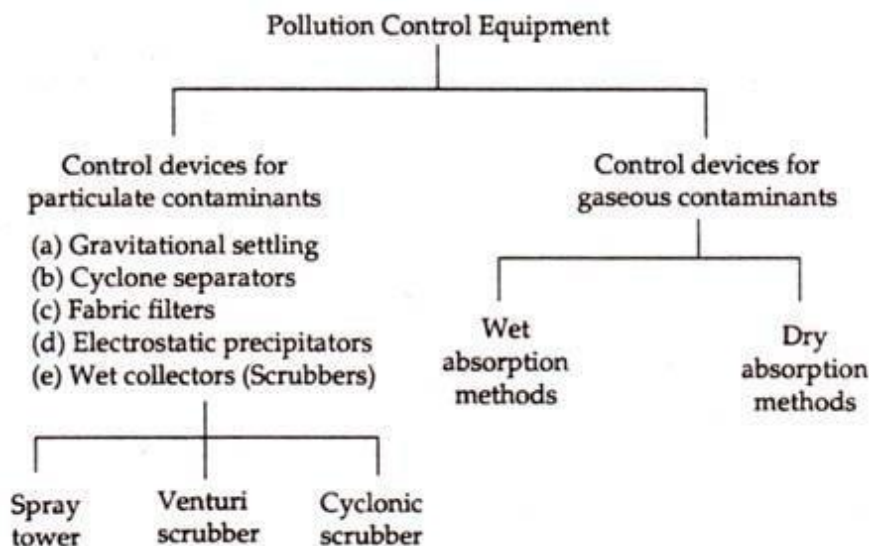
(b) Pollution Control Equipment:

Sometimes pollution control at source is not possible by preventing the emission of pollutants. Then it becomes necessary to install pollution control equipment to remove the gaseous pollutants from the main gas stream. The pollutants are present in high concentration at the source and as their distance from the source increases they become diluted by diffusing with environmental air.

Pollution control equipment's are generally classified into two types:

(a) Control devices for particulate contaminants.

(b) Control devices for gaseous contaminants.



In the present book only the control devices for particulate contaminants are dealt with.

Control Devices for Particulate Contaminants:

(1) *Gravitational Settling Chamber:*

For removal of particles exceeding 50 μm in size from polluted gas streams, gravitational settling chambers are put to use.

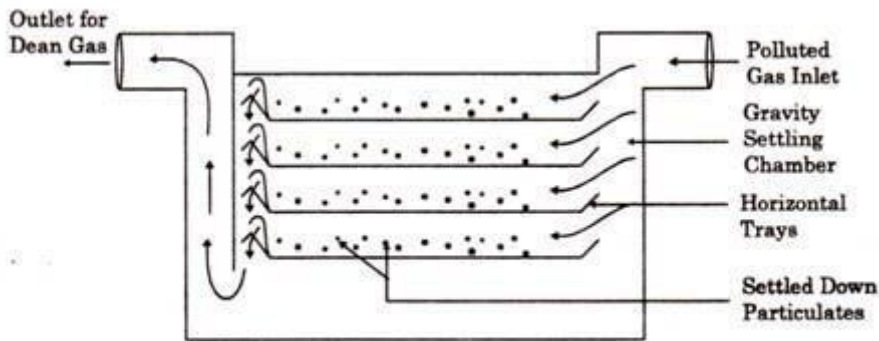


Fig. 5.1 Gravitational Settling Chamber

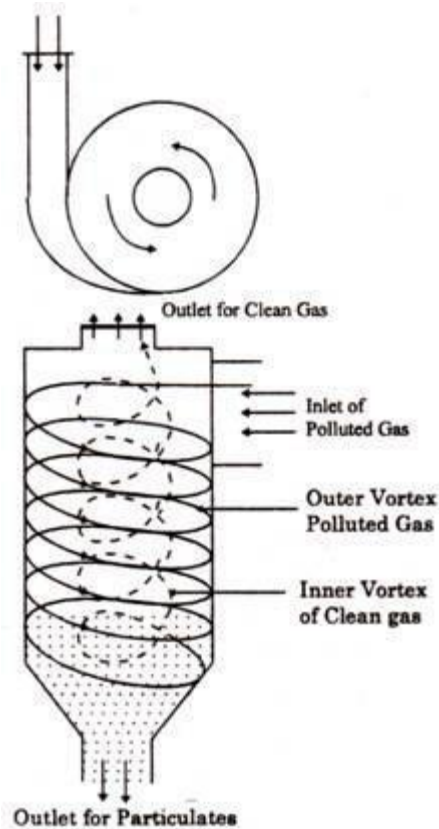
This device consists of huge rectangular chambers. The gas stream polluted with particulates is allowed to enter from one end. The horizontal velocity of the gas stream is kept low (less than 0.3 m/s) in order to give sufficient time for the particles to settle by gravity.

The particulates having higher density obey Stoke's law and settle at the bottom of the chamber from where they are removed ultimately. The several horizontal shelves or trays improve the collection efficiency by shortening the settling path of the particles.

(2) *Cyclone Separators (Reverse flow Cyclone):*

Instead of gravitational force, centrifugal force is utilized by cyclone separators, to separate the particulate matter from the polluted gas. Centrifugal force, several times greater than gravitational force, can be generated by a spinning gas stream and this quality makes cyclone separators more effective in removing much smaller particulates than can possibly be removed by gravitational settling chambers.

A simple cyclone separator (Fig 5.2) consists of a cylinder with a conical base. A tangential inlet discharging near the top and an outlet for discharging the particulates is present at the base of the cone.



**Fig. 5.2. Cyclone Separator
(Reverse Flow Cyclone)**

Mechanism of Action:

The dust laden gas enters tangentially, receives a rotating motion and generates a centrifugal force due to which the particulates are thrown to the cyclone walls as the gas spirals upwards inside the cone (i.e. flow reverses to form an inner vortex which leaves flow through the outlet). The particulates slide down the walls of the cone and are discharged from the outlet.

(3) Fabric Filters (Baghouse Filters):

In a fabric filter system, a stream of the polluted gas is made to pass through a fabric that filters out the particulate pollutant and allows the clear gas to pass through. The particulate matter is left in the form of a thin dust mat on the insides of the bag. This dust mat acts as a filtering medium for further removal of particulates increasing the efficiency of the filter bag to sieve more sub-micron particles ($0.5 \mu\text{m}$).

A typical filter (Fig 5.3) is a tubular bag which is closed at the upper end and has a hopper attached at the lower end to collect the particles when they are dislodged from the fabric. Many such bags are hung in a baghouse. For efficient filtration and a longer life, the filter bags must be

cleaned occasionally by a mechanical shaker to prevent too many particulate layers from building up on the inside surfaces of the bag.

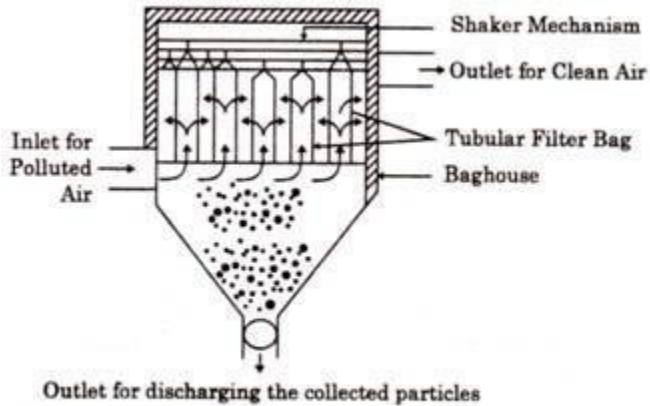


Fig. 5.3 Fabric Filter (Baghouse Filter)

(4) Electrostatic Precipitators:

The electrostatic precipitator (Fig. 5.4) works on the principle of electrostatic precipitation i.e. electrically charged particulates present in the polluted gas are separated from the gas stream under the influence of the electrical field.

A typical wire and pipe precipitator consists of:

- (a) A positively charged collecting surface (grounded).
- (b) A high voltage (50 KV) discharge electrode wire.
- (c) Insulator to suspend the electrode wire from the top.
- (d) A weight at the bottom of the electrode wire to keep the wire in position.

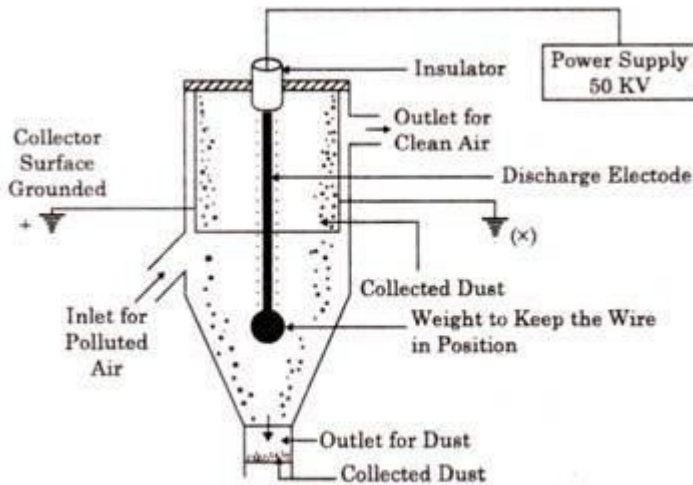


Fig. 5.4 Electrostatic Precipitator

Mechanism of Action:

The polluted gas enters from the bottom, flows upwards (i.e. between the high voltage wire and grounded collecting surface). The high voltage in the wire ionizes the gas. The negative ions migrate towards the grounded surface and pass on their negative charge to the dust particles also. Then these negatively charged dust particles are electrostatically drawn towards the positively charged collector surface, where they finally get deposited.

The collecting surface is rapped or vibrated to periodically remove the collected dust-particles so that the thickness of the dust layer deposited does not exceed 6 mm, otherwise the electrical attraction becomes weak and efficiency of the electrostatic precipitator gets reduced.

As the electrostatic precipitation has 99 + percent efficiency and can be operated at high temperatures (600°C) and pressure at less power requirement, therefore, it is economical and simple to operate compared to other devices.

(5) Wet Collectors (Scrubbers):

In wet collectors or scrubbers, the particulate contaminants are removed from the polluted gas stream by incorporating the particulates into liquid droplets.

Common wet scrubbers are:

- (i) Spray Tower
- (ii) Venturi Scrubber

(iii) Cyclone Scrubber

(i) Spray Tower:

Water is introduced into a spray tower by means of a spray nozzle (i.e. there is downward flow of water). As the polluted gas flows upwards, the particulates (size exceeding $10\ \mu\text{m}$) present collide with the water droplets being sprayed downward from the spray nozzles. Under the influence of gravitational force, the liquid droplets containing the particulates settle to the bottom of the spray tower.

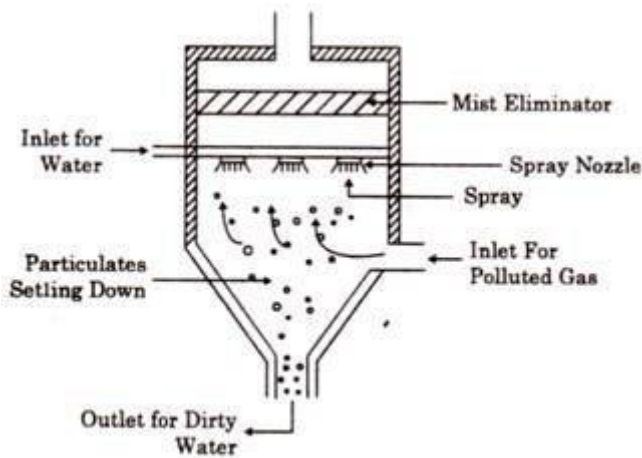


Fig. 5.5. Spray Tower

(ii) Venturi Scrubber:

Submicron particulates (size 0.5 to $5\ \mu\text{m}$) associated with smoke and fumes are very effectively removed by the highly efficient Venturi Scrubbers. As shown in Fig 5.6 a Venturi Scrubber has a Venturi shaped throat section. The polluted gas passes downwards through the throat at the velocity of 60 to $180\ \text{m/sec}$.

A coarse water stream is injected upwards into the throat where it gets atomized (i.e. breaks the water into droplets) due to the impact of high velocity of the gas. The liquid droplets collide with the particulates in the polluted gas stream.

The particles get entrained in the droplets and fall down to be removed later on. Venturi Scrubbers can also remove soluble gaseous contaminants. Due to the atomization of water there is proper contact between the liquid and the gas increasing the efficiency of the Venturi Scrubber (their power cost is high because of the high inlet gas velocity).

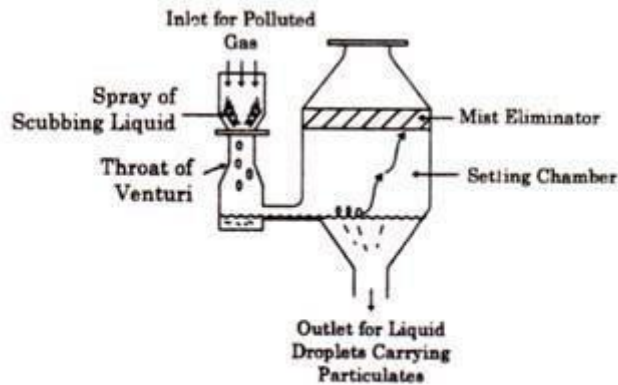


Fig. 5.6. Venturi Scrubber Connected to a Cyclone Separator

To separate the droplets carrying the particulate matter from the gas stream, this gas-liquid mixture in the Venturi Scrubber is then directed into a separation device such as a cyclone separator.

(iii) Cyclone Scrubber:

The dry cyclone chamber can be converted into a wet cyclone scrubber by inserting high pressure spray nozzles at various places within the dry chamber

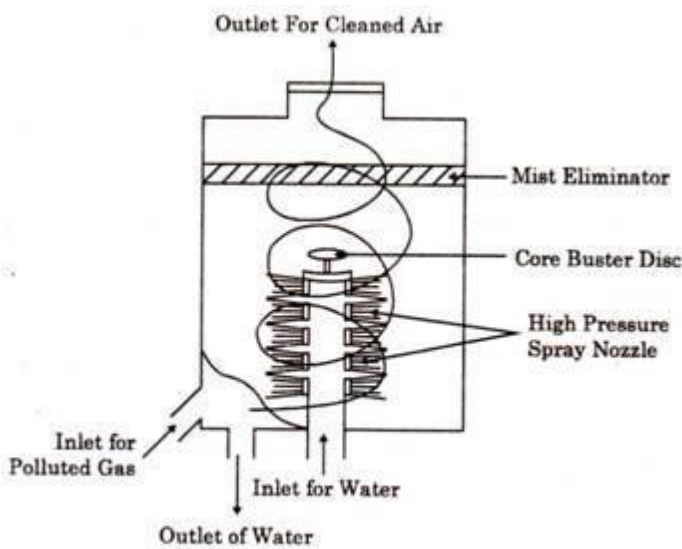


Fig. 5.7. Cyclone Scrubber

The high pressure spray nozzles generate a fine spray that intercepts the small particles in the polluted gas. The centrifugal force throws these particles towards the wall from where they are drained downwards to the bottom of the scrubber.

(c) Diffusion of Pollutants in Air:

Dilution of the contaminants in the atmosphere is another approach to the control of air pollution. If the pollution source releases only a small quantity of the contaminants, then pollution is not noticeable as these pollutants easily diffuse into the atmosphere but if the quantity of air contaminants is beyond the limited capacity of the environment to absorb the contaminants, then pollution is caused.

However, dilution of the contaminants in the atmosphere can be accomplished through the use of tall stacks which penetrate the upper atmospheric layers and disperse the contaminants so that the ground level pollution is greatly reduced. The height of the stacks is usually kept 2 to 2^{1/2} times the height of nearby structures.

Dilution of pollutants in air depend on atmospheric temperature, speed and direction of the wind. The disadvantage of the method is that it is a short-term contact measure which in reality brings about highly undesirable long-range effects.

This is so because dilution only dilutes the contaminants to levels at which their harmful effects are less noticeable near their original source whereas at a considerable distance from the source these very contaminants eventually come down in some form or another.

(d) Vegetation:

Plants contribute towards controlling air-pollution by utilizing carbon dioxide and releasing oxygen in the process of photosynthesis. This purifies the air (removal of gaseous pollutant—CO₂) for the respiration of men and animals.

Gaseous pollutants like carbon monoxide are fixed by some plants, namely, *Coleus Blumeri*, *Ficusvariegata* and *Phaseolus Vulgaris*. Species of *Pinus*, *Quercus*, *Pyrus*, *Juniperus* and *Vitis* depollute the air by metabolizing nitrogen oxides. Plenty of trees should be planted especially around those areas which are declared as high-risk areas of pollution.

(e) Zoning:

This method of controlling air pollution can be adopted at the planning stages of the city. Zoning advocates setting aside of separate areas for industries so that they are far removed from the residential areas. The heavy industries should not be located too close to each other.

New industries, as far as possible, should be established away from larger cities (this will also keep a check on increasing concentration of urban population in a few larger cities only) and the locational decisions of large industries should be guided by regional planning. The industrial estate of Bangalore is divided into three zones namely light, medium and large industries. In Bangalore and Delhi very, large industries are not permitted.

Water pollution

Water they say is life, and indeed they were right. With about 70% of the earth's cover being water, it undeniably becomes one of our greatest resources. As young students, we learned about the various ways to conserve water; coming to think of it, water is used in almost every important human chores and processes. It is an important element in both domestic as well as industrial purposes. However, a closer inspection of our water resources today, give us a rude shock.

Infested with waste ranging from floating plastic bags to chemical waste, our water bodies have turned into a pool of poison. The contamination of water bodies in simplest words means water pollution. Thereby the abuse of lakes, ponds, oceans, rivers, reservoirs etc is water pollution. Pollution of water occurs when substances that will modify the water in negative fashion are discharged in it. This discharge of pollutants can be direct as well as indirect.

Water pollution is an appalling problem, powerful enough to lead the world on a path of destruction. Water is an easy solvent, enabling most pollutants to dissolve in it easily and contaminate it. The most basic effect of water pollution is directly suffered by the organisms

and vegetation that survive in water, including amphibians. On a human level, several people die each day due to consumption of polluted and infected water.

Sources of Water Pollution

There are various classifications of water pollution. The two chief sources of water pollution can be seen as **Point and Non-Point**.

Point refers to the pollutants that belong to a single source. An example of this would be emissions from factories into the water.

Non-Point on the other hand means pollutants emitted from multiple sources. Contaminated water after rains that has traveled through several regions may also be considered as a non-point source of pollution.

Causes of Water Pollution

Let us now study the causes of water pollution.

1. Industrial waste: Industries produce huge amount of waste which contains toxic chemicals and pollutants which can cause air pollution and damage to us and our environment. They contain pollutants such as lead, mercury, Sulphur, asbestos, nitrates and 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 and 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 and pose serious hazard to water organisms.

2. Sewage and waste water: The sewage and waste water that is produced by each household is 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 house 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 via various forms of contact onto an individual. A very common example of this process would be Malaria.

3. 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 contains harmful chemicals and can increase the number of toxic elements when mixed up with water which may result in health problems. Mining activities emit several metal waste and sulphones from the rocks and is harmful for the water.

4. Marine dumping: The garbage produces by each household in the form of paper, aluminum, rubber, glass, plastic, food if collected and deposited into the sea in some countries. These items take from 2 weeks to 200 years to decompose. When such items enter the sea, they not only cause water pollution but also harm animals in the sea.

5. Accidental Oil leakage: Oil spill poses 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.

6. 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 vapor result in acid rain. Also, carbon dioxide is released from burning of fossil fuels which result in global warming.

7. 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. However, when these chemicals are mixed up with water produce harmful for plants and animals. Also,

when it rains, the chemicals mix up with rainwater and flow down into rivers and canals which pose serious damages for aquatic a**8. 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.

9. Global warming: An increase in earth's temperature due to 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.

10. 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 of to prevent any nuclear accident. Nuclear waste can have serious environmental hazards if not disposed of properly. Few major accidents have already taken place in Russia and Japan.

11. Urban development: As population has grown, so has the demand for housing, food and cloth. As more cities and towns are developed, they have resulted in increased use of fertilizers to produce more food, soil erosion due to deforestation, increase in construction activities, inadequate sewer collection and treatment, landfills as more garbage is produced, increase in chemicals from industries to produce more materials.

12. Leakage from the landfills: Landfills are nothing but huge pile of garbage that produces awful smell and can be seen across the city. When it rains, the landfills may leak and the leaking landfills can pollute the underground water with large variety of contaminants.

13. Animal waste: The waste produce by animals is washed away into the rivers when it rains. It gets mixed up with other harmful chemicals and causes various water borne diseases like cholera, diarrhea, jaundice, dysentery and typhoid.

14. Underground storage leakage: Transportation of coal and other petroleum products through underground pipes is well known. Accidental leakage may happen anytime and may cause damage to environment and result in soil erosion.

Water pollutants also include both organic and inorganic factors. Organic factors include volatile organic compounds, fuels, waste from trees, plants etc. Inorganic factors include ammonia, chemical waste from factories, discarded cosmetics etc. The water that travels via fields is usually contaminated with all forms of waste inclusive of fertilizers that it swept along the way. This infected water makes its way to our water bodies and sometimes to the seas endangering the flora, fauna and humans that use it along its path.

The current scenario has led to a consciousness about water preservation and efforts are being made on several levels to redeem our water resources. Industries and factory set-ups are restricted from contaminating the water bodies and are advised to treat their contaminated waste through filtration methods. People are investing in rain water harvesting projects to collect rainwater and preserve it in wells below ground level.

Water Pollution is common, and is an area of high alert. Water needs to be preserved and respected today, for us to live a tomorrow.

What is Dissolved Oxygen?

Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. In limnology (the study of lakes), dissolved oxygen is an essential factor second only to water itself ¹. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality.

Non-compound oxygen, or free oxygen (O₂), is oxygen that is not bonded to any other element. Dissolved oxygen is the presence of these free O₂ molecules within water. The bonded oxygen molecule in water (H₂O) is in a compound and does not count toward dissolved oxygen levels.

One can imagine that free oxygen molecules dissolve in water much the way salt or sugar does when it is stirred ².

Prevention of Water Pollution

Here are the top 14 ways to Prevent Water Pollution.

1. Sewage treatments: The household water should be treated properly so that they become environmentally safe. Adequate care should be taken to ensure that effective sewage treatment process is in place and that contaminated water does not get mixed with the environment. In order to prevent water pollution, human and animal excreta should be prevented from mixing with its sources. Construction of pit toilet and proper sewage treatments can offer some solution to this problem.

2. Prevent river water to get polluted: The flowing water of the river cannot be cleaned easily by natural process. Since, a large number of external substances are discharged into the water, the river water becomes polluted. This may cause diseases to the people using river water. Thus, every effort should be made to prevent the river water to get contaminated. People should not be allowed to throw wastes into the river water. Further, effective urban runoff (discharge of polluted storm water into river) mitigation system such as retention basins, infiltration basins, etc. should be in place.

3. Treatment of wastes before discharge: Factories are expected to treat its effluent wastes prior to discharge. Toxic material must be treated chemically and converted into harmless materials. If possible, factories should try to recycle the treated water.

4. Strict adherence to water laws: Laws and legislation relating to pollution should be strictly followed by all. People should be made aware that adherence to water laws are in their own interest.

5. Treatment of drainage water: In cities, a huge amount of water is put into drains every day. The water that flows through the city drainage system should be properly treated. Harmful pollutants be removed, before they are introduced into reservoirs. If this water allowed going into water reservoirs without treatment, it will pollute them.

6. Treatment plants: Big cities and towns usually have effluent treatment plants. These plants filter out undissolved materials. Chemical treatment is also given to separate out unwanted dissolved chemicals. The treated water is either allowed to go into the water reservoirs or reused in houses. Occasionally, the treated water is used for farming if the fields to be irrigated lie in the vicinity of the water treatment plants.

7. Keep the pond water clean and safe: Washing, bathing of cattle in the pond that is used by human should not be done. Washing of dirty clothes and bathing of cattle make the pond water dirty and unsuitable for human use. If these ponds are continually misused, then it may lead to severe consequences.

8. Routine cleaning: Ponds, lakes and wells meant for human use should be routinely cleaned and treated, so that it remains fit for human use. It is an essential step that should not be avoided. A system of regular testing of pond and lake water can be introduced to ensure the safety of the water.

9. Don't pour insecticides in sinks and toilets: Never pour household insecticides, medicines, etc. down the sink, drain or toilet. At homes, people often throw wastes and old medicines into the bathroom toilet. This practice is discouraged for the reason that the chemical compounds of medicines, insecticides, etc., when mixed with other chemicals, may result in formation of harmful substances.

10. Self-hygiene: Self hygiene must be maintained and drinking water must not be polluted. Drinking water should be kept under cover in a clean place. One should not put his hands into the drinking water containers. Also, the practice of cleaning the drinking water reservoirs on a

regular basis needs to be strictly followed. The water meant for drinking should be purified prior to use. In the absence of good water purifier, it is recommended to drink boiled water. This is also important to prevent water borne diseases.

11. Sanitation: Sanitation system must be improved. The benefits of cleanliness on human health need to be understood. Human contact with hazardous materials should be prevented. After using the toilet, one should always use the flush and wash their hands with soap and water.

12. Public Awareness: Common public should be aware about the effect of water pollution. Voluntary organization should go door-to-door to educate the people about environmental problems. They should perform street plays for creating awareness about the environment. They should run environmental education centers. Students can impart health education to enable people to prevent water pollution.

13. Reduce the use of water as coolant by large industries and power plants: Massive quantity of water is being used as coolant by industries and power plants. Very often, these waters are discharged in water bodies without prior treatment. Very often unnaturally hot or cool water is released into the natural water bodies. This causes sudden change in the temperature of the water is known as “thermal shock”, and it disturbs the water inhabitants badly. The water ecosystem can be saved from thermal pollution, if the water used as coolant is reused by the industries and not discharged into these natural water bodies.

14. Effective waste water management system: The municipalities of most urban cities should have robust waste water management system to minimize the risk of urban pollutants being introduced into the rivers. Tests should be in place to check the proper functioning of this system.

WHAT IS SOIL POLLUTION?

Any undesirable change in the physical, chemical or biological properties of the soil, which is harmful to environment, living organisms and plants, is called 'soil pollution'. It adversely affects human nutrition and crop production and productivity, and the quality and utility of soil. Cadmium, chromium, copper, pesticide, chemical fertilizer, weed, toxic gases etc. are major soil pollutants. For example, if pesticides are used while farming, then it affects the plants and the soil apart from killing the insects.

THE PROBLEM OF SOIL POLLUTION

The problem of soil pollution arises due to mixing of toxic and polluted materials in the soil. Illegal dumping is the biggest reason for soil pollution, which adversely affects the quality of soil and the health of people living on it. Soil pollution also spreads through polluted water absorbed by the soil. Chemical compost used in agricultural work, litter and dirt also badly pollute the soil. The soil is also polluted by the mineral oil spread on the land accidentally. Pollutants present in the air also contribute to polluting the soil. Through the rain water, pollutants present in the air descend on the ground which ultimately results into polluting the soil.

Soil is an important natural resource on Earth that is essential to run the life of humankind and animals by producing vegetation, grains and other natural substances required for food and living. Fertile soil on Earth is essential for the production of crops which is essential for the food of all living beings. Fertility of the land is severely affected due to the inclusion of toxic elements in the soil due to chemical fertilizers, pesticides,

TYPES OF SOIL POLLUTION

There are many types of natural and human-born soil pollution:

Land pollution from domestic and industrial solid waste

Electronic goods, broken furniture, junk papers, polythene bags, plastic cans, bottles, wastewater, toxic waste from the hospital etc. are examples of solid waste which pollute the soil. Most of this litter is non-biodegradable. These wastes affect the soil structure by being blocked in it for long periods. Because these solid wastes do not decay easily, they lie on landfill sites for thousands of years and keep polluting the soil and the environment continuously. In addition to the soil, humans and animals living around these landfill sites are greatly harmed.

Household waste, industrial waste etc. contain residues of harmful toxic inorganic and organic chemicals. In these residues, radiation elements such as strontium, cadmium, uranium, radon are found, which affect the vitality and fertility of the land. Fly ash is a major source of pollution surrounding the industrial area.

There are chemicals or other types of waste in industries, which are dumped at some place. So much so that soil becomes polluted and trees and plants do not even grow in such a part.

Soil pollution by chemical substances

The use of chemical pesticides and fertilizers has increased for cultivating more crops and these pollutants are making the soil poisonous and in many places the soil has become dead due to excessive use of it.

Producers of fertilizers, insecticides, pesticides, pharmaceuticals produce a lot of solid and liquid waste. Due to leaks from pipes and gutters, pollutants also go into the soil and spread pollution.

In the chemical and nuclear power plants, a large amount of waste is released continuously and due to the absence of proper arrangements for their storage and disposal, these substances pollute the soil.

In commercial agriculture, insecticides are being used indiscriminately and inorganic chemical fertilizers are also being used day by day. The chemical fertilizers are polluting the environment

and groundwater resources of phosphate, nitrogen and other organic chemical land. The most dangerous pollutants are bioactive chemicals, due to which the micro-organisms of climates and other soil are being destroyed resulting in decreased quality of soil. Toxic chemicals enter the diet chain, so that they reach the top consumer. Bioactive chemicals are also called Creeping Deaths. In the last 30 years, the use of organic chemicals has increased by more than 11 times. India alone is using 100,000 tons of bio-chemicals per annum.

Continuous deforestation

Trees absorb carbon dioxide from the air; provide oxygen for humans and other organisms. Apart from these, tree plantations are also helpful in prevention of soil pollution and erosion. Tree plantation rejuvenates the lost potency of soil. But unfortunately, we are continuously cutting trees on the millions of acres of land for the wood required for construction and the land required for the cultivation, besides mining work.

Agricultural Pollution

Many different agricultural processes contribute to soil pollution, which occurs both on the site itself and in nearby areas. Chemical fertilizers provide extra nutrients to increase crop yield, but also cause pollution that negatively impacts crops and soil quality over time. Pesticides kill insects that impact crop growth, but also harm animals and plants by contaminating the soil. Eventually, these chemicals seep into the soil and poison groundwater supplies. Rain and irrigation may also cause runoff that directs these chemicals to local waterways, or deposits them in the soil at other locations.

According to the Indian Government's Department of Education, agricultural pollution decreases soil fertility, increases erosion and kills flora and fauna. It creates an imbalance in the soil that may prevent future farming in the area. The University of Minnesota recommends bio- fertilizers to enhance crop yield without contributing to soil pollution.

Urban Activities

Many everyday human activities lead to soil pollution, both directly and indirectly. Paving and development prevent proper drainage and increase runoff, which spreads construction-related

contaminants to nearby land areas or streams. Increased waste disposal contaminates both landfills and public spaces. Trash that is improperly disposed of eventually breaks down into the soil, where it deposits any number of chemicals and pollutants into the earth. These pollutants may seep into groundwater or wash away into local waterways during a storm.

Excess waste, regardless of where it is disposed of, increases the presence of bacteria in the soil. As these bacteria break down organic waste products, they generate methane gas that contributes to global warming and poor air quality. Decomposition of waste in the soil also creates foul odors that can impact quality of life.

Recycling offers an effective method of reducing waste and limiting soil pollution from urban activities.

Industrial Waste

According to the Indian Government Department of Education, 90 percent of soil pollution is caused by industrial waste products, while much of the remaining 10 percent comes from dry cleaning and gas station waste. When this waste is improperly disposed of, it contaminates the soil with harmful chemicals. These pollutants impact plant and animal species and eventually reach local water supplies, where they contaminate drinking water. Even when this waste is sent to regulated landfills, it releases toxic fumes that may harm nearby residents. These fumes also contain chemicals that can fall back to earth in the form of acid rain, which may damage soil and other objects across the entire region.

Bioremediation is one method of removing industrial pollution from the soil, according to the University of Massachusetts. This technique requires cleanup crews to introduce healthy bacteria into the soil, where they gradually break down harmful materials and restore the balance of the soil.

What is Solid Waste Management?

Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes. It also offers solutions for recycling items that do not belong to garbage or trash. As long as people have been living in settlements and residential areas, garbage or solid waste has been an issue. Waste management is all about how solid waste can be changed and used as a valuable resource. Solid waste management should be embraced by each and every household including the business owners across the world. Industrialization has brought a lot of good things and bad things as well. One of the negative effects of industrialization is the creation of solid waste.

According to Britannica, *“Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects.”*

Noise Pollution

Most of us are very used to the sounds we hear in everyday life. Loud music, the television, people talking on their phone, the traffic and even pets barking in the middle of the night. All of these have become a part of the urban culture and rarely disturb us. However, when the sound of the television keeps you from sleeping all night or the traffic starts to give you a headache, it stops becoming just noise and start turning into noise pollution. For many of us, the concept of pollution is limited to nature and resources. However, noise that tends to disrupt the natural rhythm of life makes for one solid pollutant.

By definition, noise pollution takes place when there is either excessive amount of noise or an unpleasant sound that causes temporary disruption in the natural balance. This definition is usually applicable to sounds or noises that are unnatural in either their volume or their production. Our environment is such that it has become difficult to escape noise. Even electrical appliances at home have a constant hum or beeping sound. By and large, lack of urban planning increases the exposure to unwanted sounds. This is why understanding noise pollution is necessary to curb it in time.

Causes of Noise Pollution

1. Industrialization: Most of the industries use big machines which are capable of producing large amount of noise. Apart from that, various equipment like compressors, generators, exhaust fans, grinding mills also participate in producing big noise. Therefore, you must have seen workers in these factories and industries wearing ear plugs to minimize the effect of noise.

2. Poor Urban Planning: In most of the developing countries, poor urban planning also plays a vital role. Congested houses, large families sharing small space, fight over parking, frequent fights over basic amenities lead to noise pollution which may disrupt the environment of society.

3. Social Events: Noise is at its peak in most of the social events. Whether it is marriage, parties, pub, disc or place of worship, people normally flout rules set by the local administration and create nuisance in the area. People play songs on full volume and dance till midnight which makes the condition of people living nearby pretty worse. In markets, you can see people selling clothes via making loud noise to attract the attention of people.

4. Transportation: Large number of vehicles on roads, airplanes flying over houses, underground trains produce heavy noise and people get it difficult to get accustomed to that. The high noise leads to a situation wherein a normal person loses the ability to hear properly.

5. Construction Activities: Under construction activities like mining, construction of bridges, dams, buildings, stations, roads, flyovers take place in almost every part of the world. These construction activities take place every day as we need more buildings, bridges to accommodate more people and to reduce traffic congestion. The down point is that these construction equipment are too noisy.

6. Household Chores: We people are surrounded by gadgets and use them extensively in our daily life. Gadgets like TV, mobile, mixer grinder, pressure cooker, vacuum cleaners, washing machine and dryer, cooler, air conditioners are minor contributors to the amount of noise that is produced but it affects the quality of life of your neighborhood in a bad way.

While this form of pollution may seem harmless, it in fact has far reaching consequences. The adverse effects on the health of the environment are quite severe. Not only is the local wildlife affected by the pollution, humans also face a number of problems due to it.

Effects of Noise Pollution

1. Hearing Problems: Any unwanted sound that our ears have not been built to filter can cause problems within the body. Our ears can take in a certain range of sounds without getting damaged. Man made noises such as jackhammers, horns, machinery, airplanes and even vehicles can be too loud for our hearing range. Constant exposure to loud levels of noise can easily result in the damage of our ear drums and loss of hearing. It also reduces our sensitivity to sounds that our ears pick up unconsciously to regulate our body's rhythm.

2. Health Issues: Excessive noise pollution in working areas such as offices, construction sites, bars and even in our homes can influence psychological health. Studies show that the occurrence of aggressive behavior, disturbance of sleep, constant stress, fatigue and hypertension can be linked to excessive noise levels. These in turn can cause more severe and chronic health issues later in life.

3. Sleeping Disorders: Loud noise can certainly hamper your sleeping pattern and may lead to irritation and uncomfortable situations. Without a good night sleep, it may lead to problems related to fatigue and your performance may go down in office as well as at home. It is therefore recommended to take a sound sleep to give your body proper rest.

4. Cardiovascular Issues: Blood pressure levels, cardio-vascular disease and stress related heart problems are on the rise. Studies suggest that high intensity noise causes high blood pressure and increases heart beat rate as it disrupts the normal blood flow. Bringing them to a manageable level depends on our understanding noise pollution and how we tackle it.

5. Trouble Communicating: High decibel noise can put trouble and may not allow two people to communicate freely. This may lead to misunderstanding and you may get difficult understanding the other person. Constant sharp noise can give you severe headache and disturb your emotional balance.

6. Effect on Wildlife: Wildlife faces far more problems than humans because noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than us since their survival depends on it. The ill effects of excessive noise begin at home. Pets react more aggressively in households where there is constant noise.

They become disoriented more easily and face many behavioral problems. In nature, animals may suffer from hearing loss, which makes them easy prey and leads to dwindling populations. Others become inefficient at hunting, disturbing the balance of the eco-system.

Species that depend on mating calls to reproduce are often unable to hear these calls due to excessive man-made noise. As a result, they are unable to reproduce and cause declining populations. Others require sound waves to echo-locate and find their way when migrating. Disturbing their sound signals means they get lost easily and do not migrate when they should. To cope up with the increasing sound around them, animals are becoming louder, which may

further add to the pollution levels. This is why understanding noise pollution can help us lower the impact it has on the environment.

As of now, there do not exist many solutions to reduce sound pollution. On a personal level, everybody can help reducing the noise in their homes by lowering the volume of the radio, music system and the television. Listening to music without headphones is also a good step forward. Removal of public loudspeakers is another way in which the pollution can be countered.

As is controlling the sound levels in clubs, bars, parties and discos. Better urban planning can help in creating 'No-Noise' zones, where honking and industrial noise are not tolerated. It is only when our understanding noise pollution is complete, can we take steps to eradicate it completely.

Ways to Reduce Noise Pollution

1. **Close the windows.** By simply closing the windows, we can reduce the amount of noise entering into our homes and buildings. It keeps away unwanted sound. The best thing to do is to only open windows during the quieter times of the day, most probably late in the evenings.
2. **Put on earplugs.** Wearing earplugs is a cost-effective solution of reducing noise pollution. A pair of earplugs can be worn while sleeping or at any other time of the day when you want to reduce the amount of noise hitting your eardrums. Earplugs have their health benefits especially for those who want to have a healthy sleeping habit in noisy areas.

3. **Improve your insulation.** Insulation measures are some of the basic and most practical ways to reduce noise pollution at home. It's an art of soundproofing which helps in blocking the sound vibrations and noise. By improving insulation, it means installing soundproofing materials on the walls, ceiling and even on the floor. The use of double-pane windows can also aid in absorbing noise.
4. **Invest in noise-canceling headphones.** Majority of people may not realize this, but sound-cancelling headphones are good for reducing noise pollution. It's essentially important for industrial and construction workers. The noise cancelling headphones filters the unwanted noise before it reaches the ears.
5. **Do wall-to-wall carpeting.** Wall-to-wall carpeting comes in as another simple and practical way of reducing noise pollution. Such an undertaking goes a long way in reducing incoming noise into our homes or offices.
6. **Install a fence.** This may sound extreme, but it qualifies as a practical way to reduce noise pollution. Noise is produced by strong sound waves or vibrations which can be significantly reduced by barriers. By installing a fence, you'll be creating a barrier that absorbs the strong sound waves or vibrations thereby reducing noise pollution around your office or home.
7. **Be creative with the office or house layout.** One way to reduce noise in the house or in an office setting is getting innovative with the general layout. For instance, noisy machines can be situated in areas that are not close to the sitting/resting or working areas.
8. **Invest in noise friendly flooring.** Floors can offer impressive ways of reducing noise pollution. However, it depends on the type of floor in place. Carpeting for instance usually reduces substantial amount of noise but better results can be achieved by use of noise friendly flooring like vinyl. Vinyl is a resourceful alternative to carpeting and delivers better in reducing noise pollution because of its sound absorption qualities.

9. **Invest in sound friendly furniture.** Furniture are great sound absorbers as they reduce echo and sound vibrations. Therefore, sound friendly lounge chairs, bookshelves, couches and cabinets can have an effect on the acoustics of open spaces. For instance, in case of a noisy neighbor, put a big bookshelf against the wall to reduce the noise coming from their house or building.
10. **Use of modern acoustic wall panels.** Not all wall panels incredibly serve well at reducing noise pollution. Because of technological advancements, there are modern designs acoustic wall panel options available in the market that can effectively reduce noise pollution.
11. **Turn off the electronic or reduce the volume.** Game systems, computers, Hi-fi systems, and televisions can contribute to noise pollution when on high volumes. The solution is to turn them off when not in use and also keep them on moderate volume to reduce noise pollution. Besides, by turning them off you'll also be saving electricity costs.
12. **Plant trees.** Trees have been established to be effective in reducing noise levels within urban settings, around major highways, and even at the places we stay. Therefore, numerous plants and trees in an area mean less noise pollution. In addition to that, trees have various aesthetic advantages and improve air quality.
13. **Have a dedicated quiet space.** Having a dedicated quite space can pay off whenever we want to escape the noises that make us uncomfortable and reduce the quality of life. Quite spaces can guarantee as much as 100% soundproof areas.
14. **Install cubicles and wall partitions.** In places with large free space such as offices and other big rooms at home, wall partitioning and the use of cubicles will reduce the overall indoor noise. Cubicles and wall partitions act as noise absorbers and prove very effective even with low-level installation.

Environmental Legislation

Environmental legislation is a collection of many laws and regulations aimed at protecting the environment from harmful actions. Learn about the National Environmental Policy Act and other environmental laws.

The Environment

It feels good to step outside and breathe a big breath of fresh air. Having clean air, clean water and an environment free of toxins and pollutants has always been a desire of man. But, prior to the 1970s, there were few mechanisms in place to protect the environment and the natural resources found within the United States of America. Mounting concerns about air, water and land quality led to environmental legislation designed to protect the environment from harmful actions. In this lesson, we will learn about some groundbreaking laws and discuss how government regulations safeguard the health of our natural world.

Environmental Legislation

Environmental legislation is the collection of laws and regulations pertaining to air quality, water quality, the wilderness, endangered wildlife and other environmental factors. The umbrella of environmental legislation covers many laws and regulations, yet they all work together toward a common goal, which is regulating the interaction between man and the natural world to reduce threats to the environment and increase public health.

As you might imagine, environmental legislation is a broad topic, mainly because the natural environment encompasses so many different aspects. So, environmental laws need to consider everything, from the air we breathe to the natural resources we rely on to the plants and animals that share this world with us.

To better understand environmental law, let's look at an example. Let's say that an energy company wants to build a coal-burning power plant to create electricity for the community. Where should this power plant be built? What type of pollutants might result from the coal burning, and what measures will need to be taken to control harmful emissions? If the power plant is built at the edge of town to lessen air pollution for the human population, how will this

impact lesser species that inhabit the land downwind of the plant? These are all considerations to be evaluated within the scope of environmental law.

Environment Protection Act,1986

is an Act of the Parliament of India. In the wake of the Bhopal Tragedy, the Government of India enacted the Environment Protection Act of 1986 under Article 253 of the Constitution. Passed in March 1986, it came into force on 19 November 1986. It has 26 sections. The purpose of the Act is to implement the decisions of the United Nations Conference on the Human Environment. They relate to the protection and improvement of the human environment and the prevention of hazards to human beings, other living creatures, plants and property. The Act is an “umbrella” legislation designed to provide a framework for central government coordination of the activities of various central and state authorities established under previous laws, such as the Water Act

Central Pollution Control Board

(CPCB) of India is a statutory organization under the Ministry of Environment, Forest and Climate Change (MoE, FCC). It was established in 1974 under the Water (Prevention and Control of Pollution) Act, 1974. CPCB is also entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981. It serves as a field formation and also provides technical services to the Ministry of Environment and Forests under the provisions of the Environment (Protection) Act, 1986. It Co-ordinates the activities of the State Pollution Control Boards by providing technical assistance and guidance and also resolves disputes among them. It is the apex organization in country in the field of pollution control, as a technical wing of MoEF.^{[3][4]} The board is led by its chairman, who is nominated by the Central Government.^[5] The current acting chairman is *Shri S.P. Singh Parihar IAS* .^[6]

CPCB has its head office in New Delhi, with seven zonal offices and 5 laboratories. The board conducts environmental assessments and research. It is responsible for maintaining national standards under a variety of environmental laws, in consultation with zonal offices, tribal, and local governments. It has responsibilities to conduct monitoring of water and air quality, and maintains monitoring data. The agency also works with industries and all levels of government in a wide variety of voluntary pollution prevention programs and energy conservation efforts. It advises the central government to prevent and control water and air pollution. It also advises the Governments of Union Territories on industrial and other sources of water and air pollution. CPCB along with its counterparts the State Pollution Control Boards (SPCBs) are responsible for implementation of legislation relating to prevention and control of environmental pollution.

Environmental assessment

(EA) is the assessment of the environmental consequences (positive and negative) of a plan, policy, program, or actual projects prior to the decision to move forward with the proposed action. In this context, the term "**environmental impact assessment**" (EIA) is usually used when applied to actual projects by individuals or companies and the term "strategic environmental assessment" (SEA) applies to policies, plans and program most often proposed by organs of state.^{[1][2]} Environmental assessments may be governed by rules of administrative procedure regarding public participation and documentation of decision making, and may be subject to judicial review.

The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made".^[3] EIAs are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental

values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts.

What is global warming?

Global warming is the current increase in temperature of the Earth's surface (both land and water) as well as its atmosphere. Average temperatures around the world have risen by 0.75°C (1.4°F) over the last 100 years about two thirds of this increase has occurred since 1975.^{1 2} In the past, when the Earth experienced increases in temperature it was the result of natural causes but today it is being caused by the accumulation of greenhouse gases in the atmosphere produced by human activities.³

The natural greenhouse effect maintains the Earth's temperature at a safe level making it possible for humans and many other lifeforms to exist.⁴ However, since the Industrial Revolution human activities have significantly enhanced the greenhouse effect causing the Earth's average temperature to rise by almost 1°C . This is creating the global warming we see today. To put this increase in perspective it is important to understand that during the last ice age, a period of massive climate change, the average temperature change around the globe was only about 5°C .^{5 6}

Greenhouse effect

The **greenhouse effect** is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere.

If a planet's atmosphere contains radiatively active gases (i.e., greenhouse gases) they will radiate energy in all directions. Part of this radiation is directed towards the surface, warming it.^[3] The intensity of the downward radiation – that is, the strength of the greenhouse effect – will depend on the atmosphere's temperature and on the amount of greenhouse gases that the atmosphere contains.

Earth's natural greenhouse effect is critical to supporting life. Human activities, mainly the burning of fossil fuels and clearing of forests, have strengthened the greenhouse effect and caused global warming.

The term "greenhouse effect" arose from a faulty analogy with the effect of sunlight passing through glass and warming a greenhouse.

Acid rain

Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions (low pH). It can have harmful effects on plants, aquatic animals and infrastructure. Acid rain is caused by emissions of Sulphur dioxide and nitrogen oxide, which react with the water molecules in the atmosphere to produce acids. Some governments have made efforts since the 1970s to reduce the release of Sulphur dioxide and nitrogen oxide into the atmosphere with positive results. Nitrogen oxides can also be produced naturally by lightning strikes, and Sulphur dioxide is produced by volcanic eruptions. Acid rain has been shown to have adverse impacts on forests, freshwaters and soils, killing insect and aquatic life-forms, causing paint to peel, corrosion of steel structures such as bridges, and weathering of stone buildings and statues as well as having impacts on human health.

Types of Disaster Body

Learn about the different types of natural and human-caused disasters and their impact on behavioral health.

Natural and human-caused disasters affect thousands of people each year. Major adverse events such as these have the potential to cause catastrophic loss of life and physical destruction. They are often unexpected and can leave whole communities in shock.

People who live through a disaster can experience emotional distress. Feelings of anxiety, constant worrying, trouble sleeping, and other depression-like symptoms are common responses to disasters before, during, and after the event. Many people are able to “bounce back” from disasters with help from family and the community, but others may need additional support to cope and move forward on the path of recovery. Anyone can be at risk, including survivors living in the impacted areas and first responders and recovery workers.

Natural Disasters

Natural disasters are large-scale geological or meteorological events that have the potential to cause loss of life or property. These types of disasters include:

- Tornadoes and Severe Storms
- Hurricanes and Tropical Storms
- Floods
- Wildfires
- Earthquakes
- Drought

Severe storms and floods are the most common types of natural disasters reported in the United States. These meteorological events are occasionally preceded by presidential “emergency declarations” requiring state and local planning prior to the event, such as evacuations and protection of public assets. Disaster Distress Helpline staff are available to speak to those who call or text before, during, and after a natural disaster.

Human-Caused Disasters

Examples include industrial accidents, shootings, acts of terrorism, and incidents of mass violence. As with natural disasters, these types of traumatic events may also cause loss of life and property. They may also prompt evacuations from certain areas and overwhelm behavioral health resources in the affected communities.

In the aftermath of the tragic loss of life that occurred on September 11, 2001, the feelings of loss of security and well-being—arguably the most crucial ingredients for leading a happy, healthy life—dramatically affected the citizens of the United States. Disaster Distress Helpline staff are also trained to respond to calls or texts related to these types of disasters.

- Toolkit of Behavioral Health Resources Pertaining to the Israel-Hamas Conflict (PDF | 371)
- Incidents of Mass Violence

Other Incidents of Mass Trauma

Infectious disease outbreaks, incidents of community unrest, and other types of traumatic events can also bring out strong emotions in people. The Disaster Distress Helpline provides immediate crisis counseling to people affected by traumatic events.

- Coping with Grief After Community Violence – 2014
- Coping with Stress During Infectious Disease Outbreaks – 2014
- Talking with Children: Tips for Caregivers, Parents, and Teachers During Infectious Disease Outbreaks – 2014

Disaster preparedness

Disaster preparedness consists of a set of measures undertaken in advance by governments, organisations, communities, or individuals to better respond and cope with the immediate aftermath of a disaster, whether it be human-induced or caused by natural hazards. The objective is to reduce the loss of life and livelihoods.

Simple initiatives can go a long way, for instance in training for search and rescue, establishing early warning systems, developing contingency plans, or stockpiling equipment and supplies.

Disaster preparedness plays an important role in building the resilience of communities.

Why is this important?

With increasing population growth, rapid and unplanned urbanization, climate change, environmental degradation and widespread poverty, a growing number of people and assets are exposed to disasters.

Moreover, many of these events occur in fragile and conflict-affected states, thus increasing the complexity of crises and overburdening countries experiencing violent conflict or fragile governance.

However, improved practice and response mechanisms save lives and strengthen the countries and communities' ability to reduce the impact of disasters.

Understanding the occurrence and frequency of natural hazards, as well as the risks, vulnerabilities and potential impact on people and assets, helps to improve preparedness.

Instead of providing emergency response only, international efforts should help governments and communities invest in understanding risks and building preparedness capacities for pre-emptive and early action. Disaster preparedness is cost-effective and saves aid money.

These concepts are agreed upon and firmly embedded into international commitments, including the 2015 Sendai Framework for Disaster Risk Reduction, the Paris Agreement (2015), the Agenda 2030, the New Urban Agenda, and the Grand Bargain commitments.

The approach promotes multi-hazard preparedness and anticipatory action as a means for a quicker and more effective response. It focuses not only on disasters related to natural hazards but also on human-induced threats like conflict and violence, epidemics, and biological hazards.

Under this approach, the EU aims to mainstream preparedness and risk reduction measures across all its humanitarian programming.

In addition, the EU allocates more than €78 million of its annual humanitarian funding to targeted preparedness actions. This funding strengthens the ability of national and local preparedness systems to respond earlier and better.

The EU invests in early warning systems, monitoring and building national and local capacities for the response.

Some examples of disaster preparedness in EU-funded humanitarian aid interventions are:

- Support communities in Bangladesh to better forecast and act ahead of monsoon floods
- Advice local governments in the Philippines in scaling up inclusive cash assistance programmes that reach marginalized urban communities affected by disasters
- Support national and local governments in Mozambique in using drone and satellite data for disaster preparedness and to assess the extent of people's needs following a natural hazard
- Strengthening emergency preparedness and response in the Caribbean through better coordination of humanitarian logistics in the event of a natural hazard.

More examples of the EU's action in disaster preparedness are available in the Compendium of experiences published in 2020.

Each disaster preparedness strategy and funding allocation includes a defined exit strategy where local capacities are deemed adequate or where local governments or development partners can take over.

Additionally, the EU engages and supports local and national government structures in all countries worldwide through the EU Civil Protection Mechanism, notably within the areas of prevention and preparedness.

Facts & figures

The EU is supporting early warning and monitoring systems, and funds projects to strengthen disaster response capacities at national and local levels

In 2022, the EU invested **€76.5 million** in **69 disaster preparedness actions** in more than **40 countries**.

In 2023, the budget for targeted disaster preparedness actions amounts to over **€78 million**.