ENVIRONMENTAL ISSUES

POLLUTION

Pollution : "Any undesirable change in physical, chemical or biological characteristic of air, water and land which is harmful to the man directly or indirectly through his animals, plants, industrial units or raw materials is called pollution".

Pollutants : "Any material or act on the part of man, or nature which leads to pollution is called pollutants."

In order to control environmental pollution, the Government of India has passed the Environment (Protection) Act, 1986 to protect and improve the quality of our environment (air, water and soil).

AIR POLLUTION

The air pollution is caused due to addition of unwanted substances or gases.

In India, the Air (Prevention and Control of Pollution) Act came into force in 1981, but was amended in 1987 to include noise as an air pollutant.

There are two main categories of air pollutants

(i) **Gases** :The gaseous materials include various gases and vapours of volatile substances or the compound with a boiling point below 200^0C.

(ii) **Particulate matter** : Particulate matter consist of solid particles or liquid droplets (aerosols) small enough to remain suspended in air e.g. soot, smoke, dust, asbestos, fibres, pesticides, some metals (including Hg, Pb, Cu and Fe) and also biological agent like tiny dust mites and flower pollen.

According to Central Pollution Control Board (CPCB), particulate size 2.5 micrometers or less in diameter (PM 2.5) are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, irritation, inflammations and damage to the lungs and premature deaths.

Major Air Pollutants and Their Effects

Primary pollutants

S.NO	*NAME OF THE AIR POLLUTANTS*	*SOURCES*	*EFFECTS*
1.	Carbon monoxide	Smoke of automobile	It combines with haemoglobin, blocks the transportation of oxygen causes death due to asphyxiation
2.	CO_2	Burning of coal/ timber	It leads to global warming.
3.	Nitrogen oxides	Burning (combustion)of fossil fuel	Form photochemical smog, acid rain, emphysema, bronchitis, swelling of lungs and lungs cancer etc
4.	Sulphur dioxide	Coal burning, smelters, oil refineries	Lichen and mosses do not grow in SO_2 polluted areas due to chlorophyll destruction, stone leprosy.
5.	Unburnt hydrocarbon	Automobiles and burning of fossil fuel (petrol, diesel).	Hydrocarbons causes lungs cancer.

Secondary Pollutants

S.NO	POLLUTANT	SITE/CAUSE	COMPOSITION	EFFECTS
1.	Los angeles smog or Photo-chemical smog	Los Angeles	Reddish brown smog (PAN + O_3 + Nitrogen oxides + Light)	Irritation in eyes, harms the lungs, damage in rubbers. PAN stops or inhibits the photolysis of water and photosystem-II, inhibit chlorophyll formation
2.	London smog or sulphur smog	London smog	Coal, smoke, fog, sulphur oxide, low temperature and H_2SO_4	Due to inhalation of H_2SO_4 vapour with fog 4000 people died in London in 1952
3.	Acid rain	Refineries & Factories	H_2SO_4 and HNO_3 is 7 : 3 (70% H_2SO_4 + 30% HNO_3)	Due to acid rain acidity of soil and water increases. Acid rain also causes damages historical monuments. e.g. Taj Mahal, Red Fort

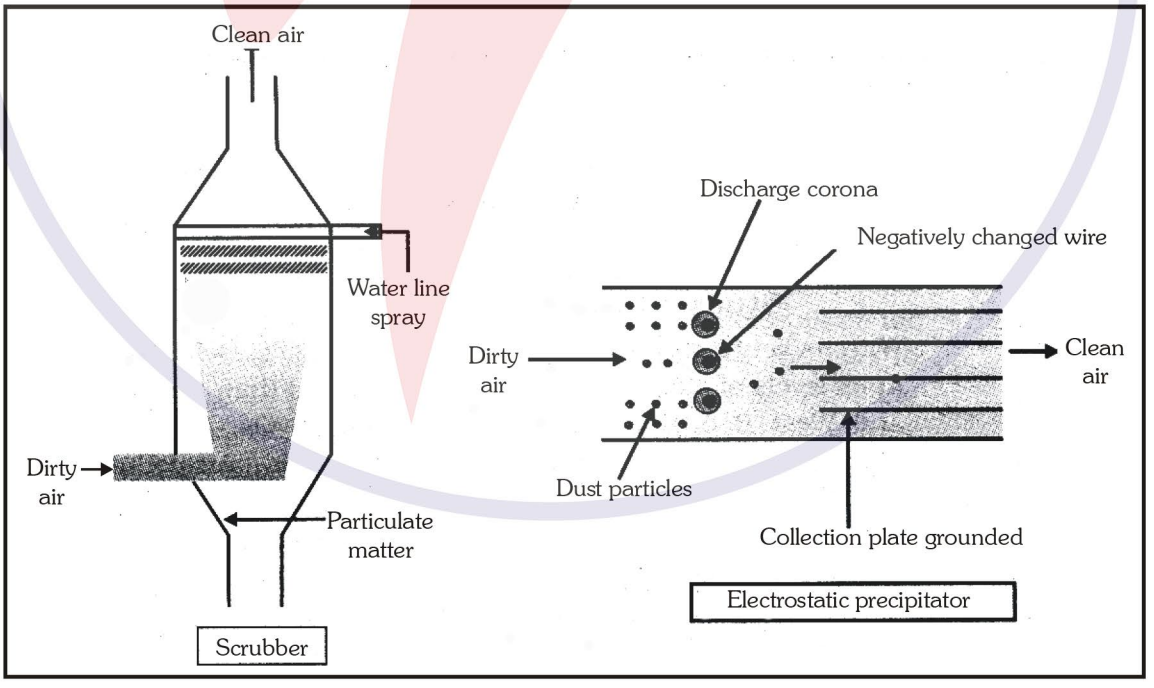
Control of Air Pollution

(a) **Electrostatic precipitator :-** There are several ways of removing **particulate** matter; the most widely used of which is the **electrostatic precipitator**, which can remove over 99 per cent particulate matter present in the exhaust from a thermal power plant.

(b) **Scrubbers**

These are used to clean air for both dust and gases. Wet and dry two types of scrubbers are used for dust separation. A scruber can remove gases like sulphurdioxide. In a scrubber, the exhaust is passed through a spray of water or lime.

(c) **Catalytic converters :** Catalytic converters, having expensive metals namely platinum – palladium and rhodium as the catalysts, are fitted into automobiles for reducing emission of poisonons gases. As the exhaust passes the catalytic converter, unburnt hydrocarbons are converted into CO_2 and water, and CO and nitric oxide are changed into CO_2 and nitrogen gas respectively.



(d) **CNG (Compressed Natural Gas) : A Case Study of Delhi**

In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world.

All the buses of Delhi were converted to run on CNG by the end of 2002.

CNG is the better than diesel because CNG burn most efficiently as compare to diesel or petrol in the automobiles and very little of it is left unbrunt. CNG is cheaper than petrol or diesel.

Type of Vehicles	Norms	Cities of Implementation
4 Wheelers	Bharat Stage III	Throughout the country since October 2010
4 Wheelers	Bharat Stage IV	13 Mega cities (Delhi and NCR, Mumbai, Kolkata, Chennai, Bangalore, Surat, Kanpur, Agra, Lucknow and Sholapur) since April,
3 Wheelers	Bharat Stage III	Throughout the country since October 2010
2 Wheelers	Bharat Stage III	Throughout the country since October 2010

Euro III norms, for example, stipulates that sulphur be controlled at **350 parts-per-million** (ppm) in diesel and **150 ppm** in petrol. Aromatic hydrocarbons are to be contained at **42 percent** of the concerned fuel. The goal, according to the roadmap, is to reduce **sulphur to 50 ppm** in petrol and diesel and bring down the level to 35 percent. Corresponding to the fuel, vehicle engines will also need to be upgraded.

Eleven most polluted cities of India - Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra.

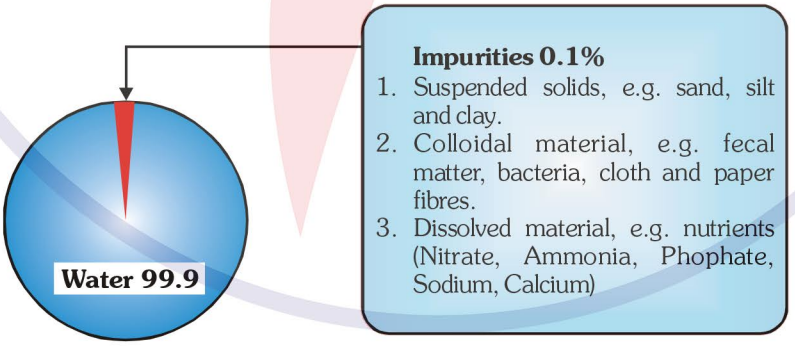
According to an estimate, a substantial fall in CO_2 and SO_2 level has been found in Delhi between 1997 and 2005.

WATER POLLUTION

The water pollution is caused by the addition of organic and inorganic chemicals as well as the biological materials which change the physical and chemical properties of water. This harmful process is called **water pollution**. Realising the importance of maintaining the cleanliness of the water bodies, the Government of India has passed the Water (Prevention and Control of Pollution) Act, 1974 to safeguard our water resources.

The water pollution is caused by many sources such as sewage matter, industrial wastage, agricultural wastage, domestic wastage, hot water of thermal plant and nuclear reactors etc.

Note : Only 0.1 per cent impurities make domestic sewage unfit for human use.

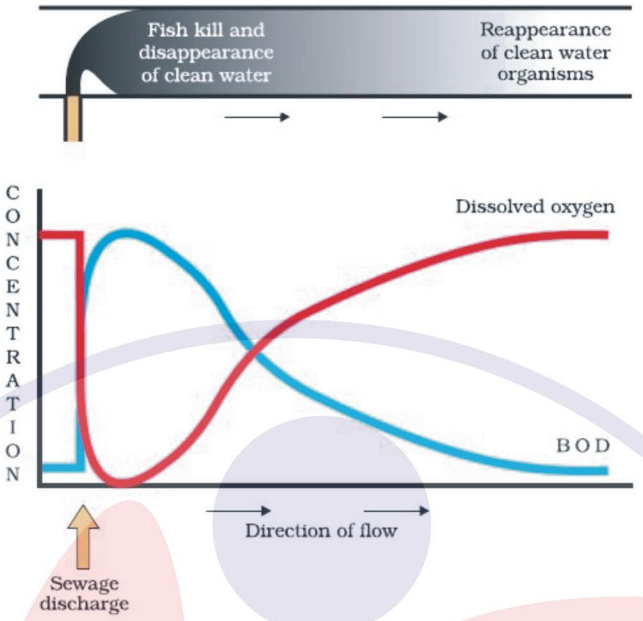


Composition of waste water

- Waste water from industries often contain toxic substance, notably heavy metals (defined as elements of density > 5 g/cm^3 such as mercury, cadmium, copper, lead, etc.) and a variety of organic compounds.
- **Biochemical Oxygen Demand (B. O. D.)**

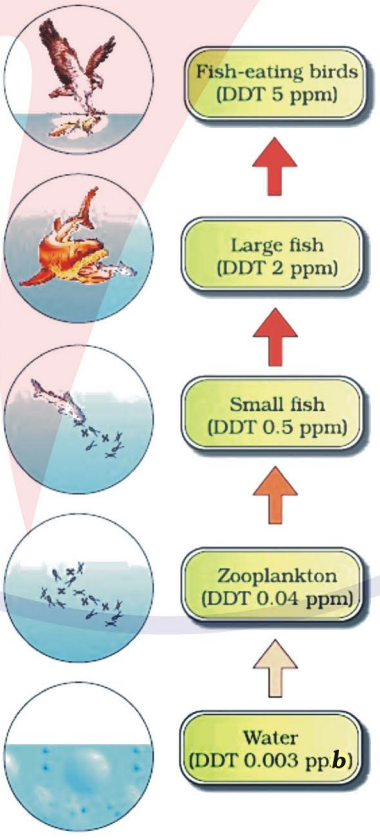
  The water pollution by organic wastes is measured in terms of Biochemical oxygen demand. It is the amount of dissolved oxygen **(D.O. = Dissolved Oxygen)** needed by bacteria in decomposing the organic wastes present in water.

  B. O. D. increased = water polluted, B. O. D. $\propto$ input of organic wastes



Effect of sewage discharge on some important characteristics of a river

- **Biological magnification**
  - The non biodegradable pollutant like Al, Hg, Fe, D. D. T., pesticides, phenolic compound ABS (Alkyl benzene sulphonate) are not decomposed by micro-organisms.
  - They get accumulated in tissue in increasing concentration along the food chain is called biological magnification. **The highest concentration occur's in top consumer.**



Biomagnification of DDT in an aquatic food chain

Note : High concentration of DDT distrub calcium metabolism in birds, which causes thinning of egg shell and their permature breaking, eventually causing decline in bird populations.

Eutrophication

- The process of nutrient enrichment of water and consequent loss of species diversity (or death of aquatic animals) is referred to as eutrophication and lake is known as eutrophic lake. In this process presence of nutrients in lake stimulates growth of algae (algal bloom) increase organic loading and bring about reduction in the oxygen content of water causing death of aquatic animals.
- It takes thousands of years.
- Accelarated eutrophication is faster because it is influenced by human activities.
- B.O.D. of Eutrophic lake is very high.

Water Pollution can be Caused by the Following Man Made Sources

Household Detergents

Waste release from household

Industrial waste

Industrial waste mainly contains inert suspended particles such as dust, coal, toxins like acid, base phenols, cyanides, mercury, zinc etc., **The minimata disease was caused in Japan by eating of polluted fishes from the water polluted by mercury**. So, many humans died because of this disease.

Sewage

- Sewage contains highest amount of carbonic materials and biological material, as pollutants. These carbonic materials increase the number of decomposers like bacteria and fungus. The acceleration of microbial activity increases BOD of water.

A case Study of Integrated Waste Water Treatment

FOAM (Friends of Arcata Marsh) : An example of such an initiative is the town of **Arcata**, situated along the northern coast of California. Collaborating with biologists from the **Humboldt State University**, the townspeople created an integrated waste water treatment process within a natural system.

The cleaning occurs in two stages

(i) Physical & Chemical Treatment to remove solid wastes.

(ii) Biological Treatment by a series of **six connected marshes.** Appropriate plants, algae, fungi and bacteria were seeded into this area, which neutralise, absorb and assimilate the pollutants and havey metals.

- **EcoSan' toilets :** Ecological sanitation is a sustainable system for handling human excreta, using dry composting toilets. There are working 'EcoSan' toilets in many areas of Kerala and Sri Lanka.

Solid Wastes

- Solid wastes refer to evgerything that goes out in trash. Municipal solid wastes are wastes from homes, offices, stores, schools, hospitals, etc., that are collected and disposed by the municipality. The municipal solid wastes generally comprise paper, food wastes, plastics, glass, metals, ruber, leather, textile, etc. Burning reduces the volume of the wastes, although it is generally not burnt to completion and open dumps often serve as the breeding ground for rats and flies. **Sanitary landfills** were adopted as the substitute for open-burning dumps. In a sanitary landfill, wastes are dumped in a depression or trench after compaction, and covered wth **dirt everyday**.

Case Study of Remedy for Plastic Waste

An initiated taken by **Ahmed Khan,** in collaboration with **R.V. College of Engineering** and the **Bangalore City Corporation**. He realised that plastic waste was a real problem. **Polyblend**, a fine powder of recycled modified plastic, was developed then by his company. This mixture is mixed with the **bitumen** that is used to lay roads.

AGRO-CHEMICALS AND THEIR EFFECTS

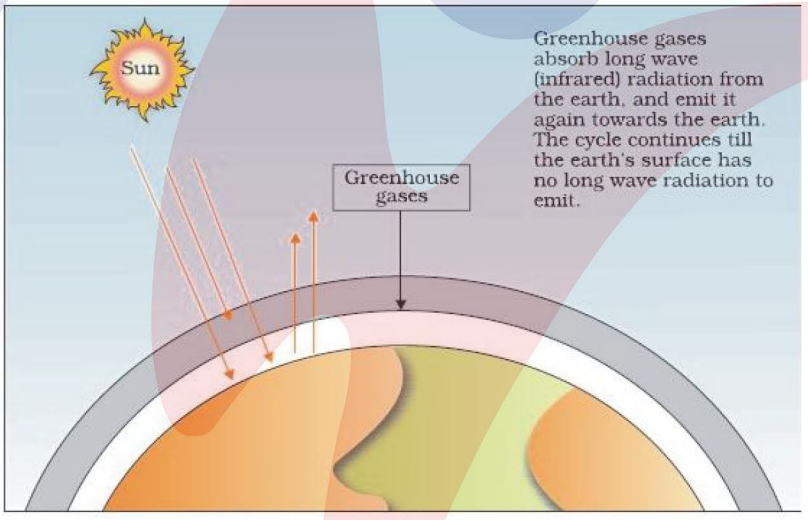
In the wake of green revolution, use of inorganic fertilisers and pesticides has increased manifold for enhancing crop production. Pesticides, herbicides, fungicides, etc., are being increasingly used. These incidentally, are also toxic to non-target organisms,that are important components of the soil ecosystem. Do you think these can be biomagnified in the terrestrial ecosystems? We know what the addition of increasing amounts of chemical fertilisers can do to aquatic ecosystems vis-à-vis eutrophication. The current problems in agriculture are, therefore, extremely grave.

Case Study of Organic Farming

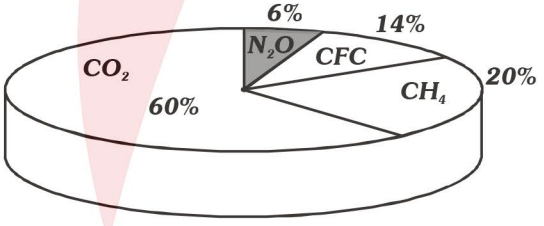
Integrated organic farming is a cyclical, **zero-waste procedure**, where waste products from one process are cycled in as nutrients for other processes. This was initiated by **Ramesh Chandra Dagar**, a farmer in **Sonipat, Haryana**. He is enthusiastic about spreading information and help on the practice of integrated organic farming. Dagar has created the **Haryana Kisan Walfare Club**, with a current membership of 5000 farmers.

GREEN HOUSE EFFECT

Higher concentration of CO_2 forms a thick layer above the earth's surface, checks the radiation of the heat from the earth surface. Because of this, temperature of the earth's surface increases, this is called **"green-house effect"** or **global warming**.



Sunlight energy at the outermost atmosphere



The relative contribution of different green house gases

In this phenomenon cover of CO_2 layer around the earth, allow the short wavelength incoming solar radiation to come in but does not allow the long wavelength of out going heat radiation from warm surface of earth and surface keep the earth warm. The consequent increase in the global mean temperature is referred to as **global warming.**

NOTE:

(i) **Carbondioxide fertilisation effect –** Due to increased CO_2 concentration the rate of photosynthesis will increase (up to a few year). The response of the plants to elevated concentration of CO_2 is known as the CO_2 fertilisation effect.

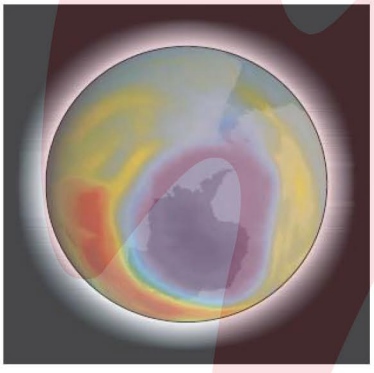
(ii) Without greenhouse effect the averge temperature at surface of Earth would have been a chilly –18°C rather than the present average of 15°C.

(iii) Increase in the level of greenhouse gases has led to considerable heating of Earth leading to global warming. During the past century, the temperature of Earth has increased by 0.6°C, most of it during the last three decades.

Kyoto protocol : Conference held in **Kyoto** (Japan) for **climate change** (1997). This protocol requires countries to take appropriate measures to reduce their overall green house gas emisson to a level at 5 percent below the 1990 level by the commitment period 2008-2012.

OZONE DEPLETION

- Ozone is present in less quantity in atmosphere. But at the height of **16 km to 25 km** on earth, concentration of ozone is maximum in stratosphere.
- At normal temperature and pressure thickness of ozone layer is **3 mm**. (But at poles thickness of ozone layer is **4 mm**).
- Ozone hole was first discovered in **1985** over Antarctica by **Nimbus-7** satelite.
- Due to depletion of ozone layer harmful **UV-B** and **UV-C** are penetrating to the earth, among them **UV-B** causes skin cancers, **damage** and **mutation** in **DNA,** inflammation of cornea (snow blindness), cataract and xeroderma pigmentosum.
- **ODS (Ozone Depleting Substances): CFC**(Chloro Flouro Carbon), Nitrogen oxides, CH_4, Halogen.
- **Some Other Informations**
  Thickness of ozone layer is measured in **Dobson unit** (1Du = 1ppb)
  The Ozone hole over Antarctica develops each year between late august and early october and in general Ozone hole occurs mainly during spring time (Feb. - Apr.) and lowest during (July - October)



Ozone hole is the area above Antarctica, shown in purple colour, where the ozone layer is the thinnest. Ozone thickness is given in Dobson unit (see carefully the scale shown in colour violet to red). The ozone hole over Antarctica develops each year between late August and early October. Courtesy: NASA

Montreal Protocol : Recognising the deleterious affects of ozone depletion, an international treaty, known as the Mantreal protocol was signed. In 1987, 27 industrialised countries signed the **Montreal** protocol at to protect **stratospheric ozone**. **Montreal (Canada)** It's effective in 1989. To, date more than 175 countries have signed the montreal protocol.

Case Study of People's Participation in Conservation of Forests

- **Case Study of People's Participation in Conservation of Forests:** People's participation has a long history in India. In 1731, a Bishnoi woman Amrita Devi showed exemplary courage by hugging a tree and daring to cut her first before cutting the tree. Her three daughters and hundreds of other Bishnois followed her, and thus lost their lives saving trees.
- The Government of India has recently instituted the Amrita Devi Bishnoi Wildlife Protection Award for individuals or communities from rural areas that has shown extraordinary courage and dedication in protecting wildlife.
- Chipko Movement: was initiated by Sundarlal Bahuguna and Chandi Prasad Bhatt at Gopeshwar in Chamoli District.
- The Government of India has introduced the concept of Joint Forest Management (JFM) in 1980s.