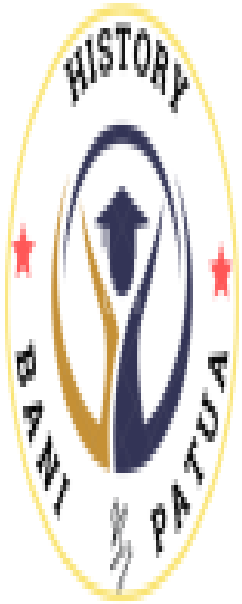

POLLUTION

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Environmental Pollution

Environmental Pollution

Pollution

Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil. Agents that bring about such an undesirable change are called as pollutants

Pollutants

Pollutants can be solid, liquid or gaseous substances present in greater concentration than in natural abundance and are produced due to human activities or due to natural happenings .

Harmful Effects of Pollution

- ✓ Pollution currently poses one of the greatest public health and human rights challenges, disproportionately affecting the poor and the vulnerable.
- ✓ Pollution is not just an environmental issue, but affects the health and well-being of entire societies.
- ✓ Despite the huge impacts on human health and the global economy, and the opportunity to apply simple and affordable solutions, pollution has been undercounted and insufficiently addressed in national policies and international development agendas.
- ✓ Pollution of all kinds can have negative effects on the environment and wildlife and often impacts human health and well-being.

Causes of Pollution

Commercial or Industrial Waste

- ✓ Commercial waste consists of waste from premises used mainly for the general purposes of a business or trade or for the purpose of recreation, education, sport, or entertainment

Rapid Urbanization

- ✓ The promise of jobs and prosperity, among other factors, pulls people to cities. Half of the global population already lives in cities, and by 2050 two-thirds of the world's people are expected to live in urban areas.

Forest Fires

- ✓ Wild fire, also called forest, bush or vegetation fire, can be described as any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes the natural fuels and spreads based on environmental conditions (e.g., wind, topography).
- ✓ Wildfire can be incited by human actions, such as land clearing, extreme drought or in rare cases by lightning.

Causes of Pollution

Increase in Population

- ✓ The recent increase in the world's population has magnified the effects of our agricultural and economic activities

Hazardous Waste

- ✓ Hazardous waste is a waste with properties that make it dangerous or capable of having a harmful effect on human health or the
- ✓ Hazardous waste is generated from many sources, ranging from industrial manufacturing process wastes to batteries and may come in many forms, including liquids, solids gases, and sludge.

Improper agricultural practices and deforestation:

- ✓ Agriculture, the very industry that sustains us, also threatens our continued existence as a species. This sector produces at least 23 percent of global greenhouse gas emissions (second only to the energy sector)-IPCC report.
- ✓ Deforestation refers to the decrease in forest areas across the world that are lost for other uses such as agricultural croplands, urbanization or mining activities.

Classification of Pollution

According to the form in which they persist after release into the Environment

Primary Pollutants

- ✓ These persist in the form in which they are added to the environment.
- ✓ Example: DDT, Plastic

Secondary Pollutants

- ✓ These are formed by interaction among the primary pollutants. For example, **peroxyacetyl nitrate (PAN)** is formed by the interaction of Nitrogen Oxides and Hydrocarbons.

Classification of Pollution

According To Their Existence In Nature

Quantitative Pollutants

- ✓ These occur in nature and become pollutant when their concentration reaches beyond a threshold level.
- ✓ Example: Carbon Dioxide, Nitrogen Oxide.

Qualitative Pollutants

- ✓ These do not occur in nature and are man-made.
- ✓ Example: Fungicides, Herbicides, DDT etc.

Classification of Pollution

According To Their Nature Of Disposal

Biodegradable Pollutants

- ✓ Waste products, which are degraded by microbial action.
- ✓ Example: Sewage.

Non-Biodegradable Pollutants

- ✓ Pollutants, which are not decomposed by microbial action.
- ✓ Example: Plastics, Glass, DDT, salts of heavy metals, radioactive substances etc

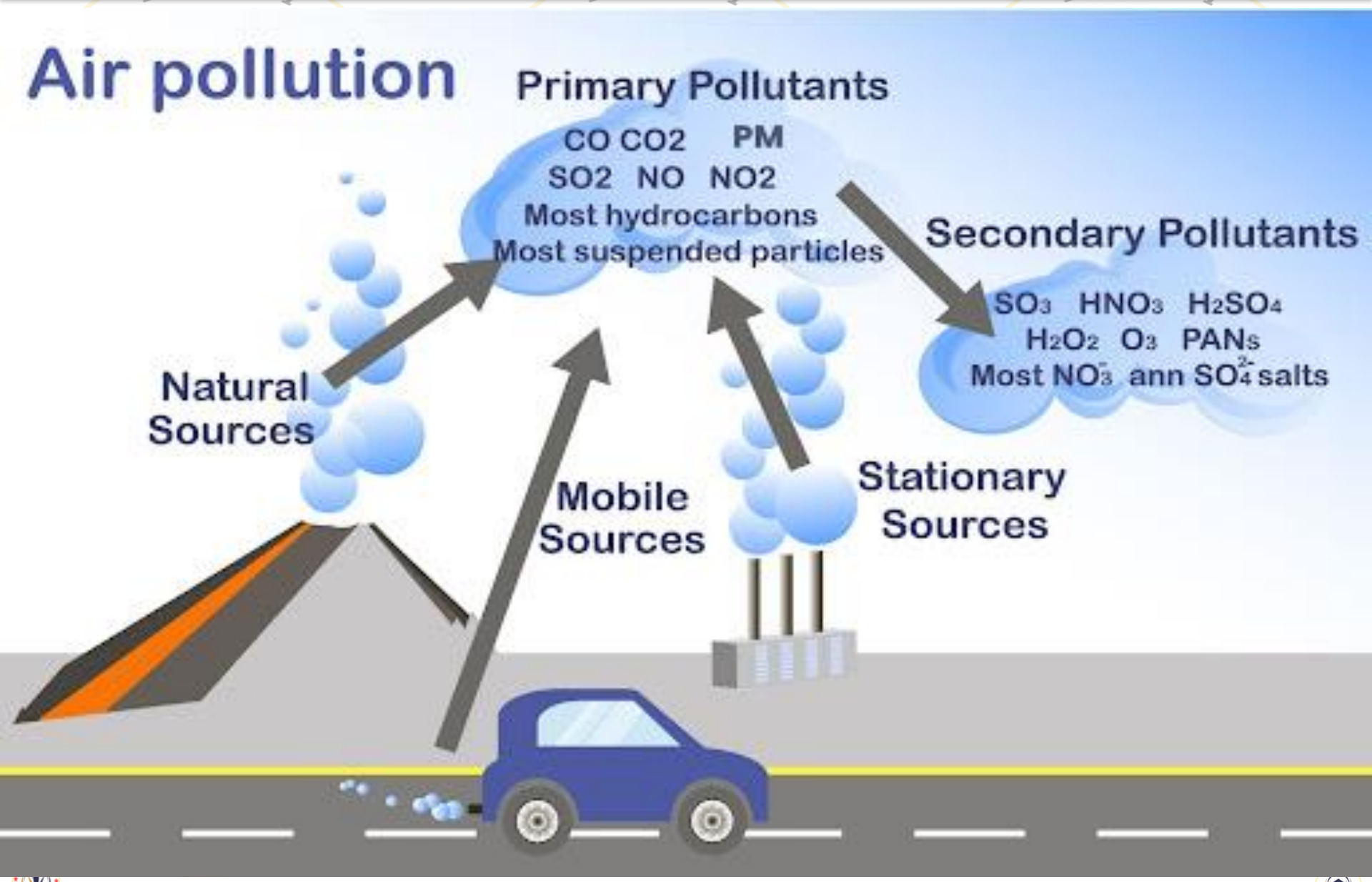
Classification of Pollution

According to Origin

Natural	
Anthropogenic	

Air Pollution

Air Pollution



Air Pollution

- ✓ **Aggravated because of four developments**: Increasing traffic, growing cities, rapid economic development, and industrialization contamination of air by the discharge of harmful substances.

- ✓ Air pollution may be defined as the presence of any solid, liquid or gaseous substance including noise and radioactive radiation in the atmosphere in such concentration that may be directly and indirectly injurious to humans or other living organisms, plants, property or interferes with the normal environmental processes.

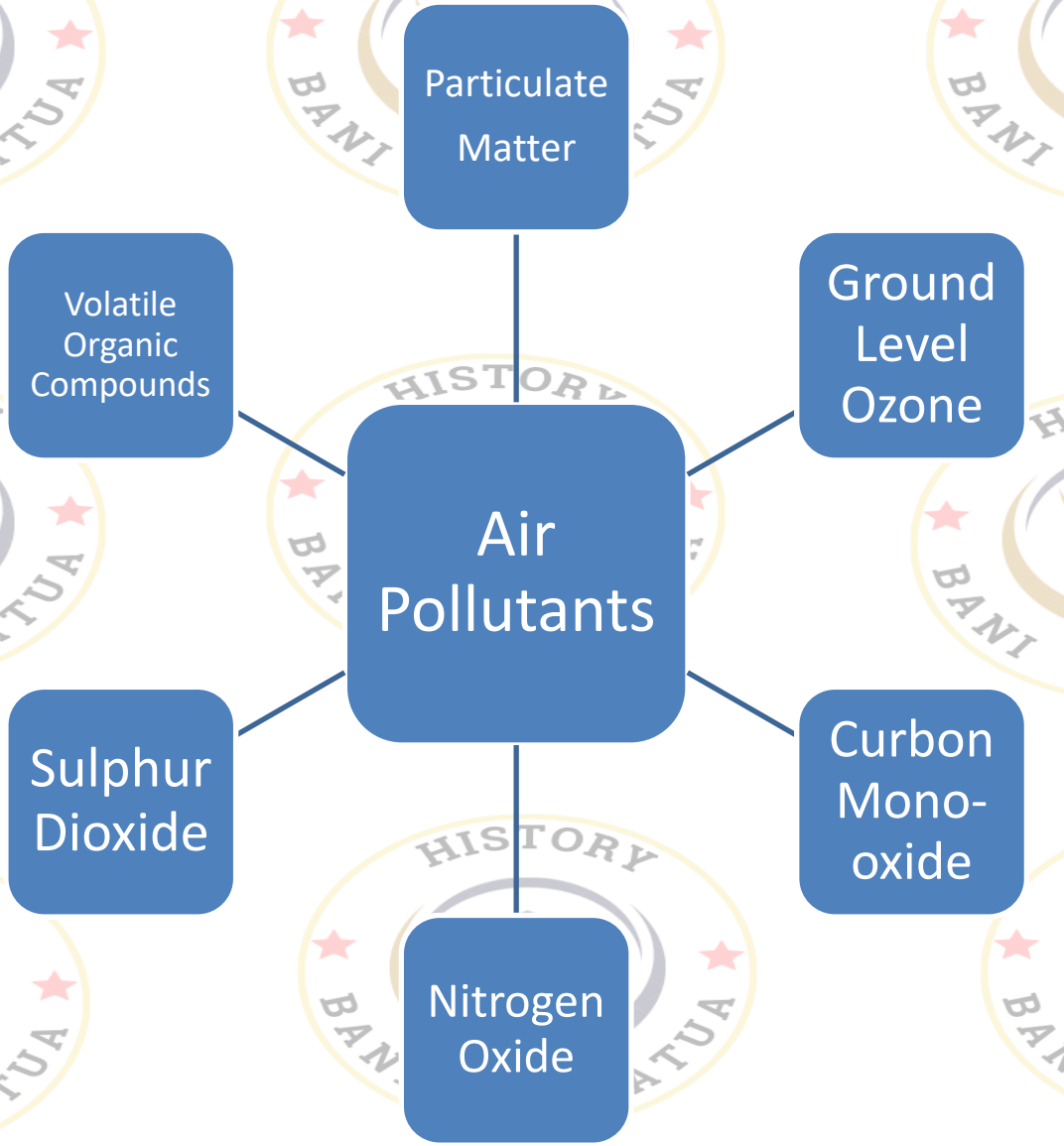
- ✓ Air pollutants are of two types
  a) suspended particulate matter, and
  b) gaseous pollutants like carbon dioxide (CO_2), NOx etc.

- ✓ Air pollution is the world's single greatest environmental risk to health, prematurely killing some 6.5 million people across the world every year and exposing nine out of ten people to unacceptable outdoor air pollution levels. It in particular affects women, children, the sick and elderly, and those in low-income groups.

Causes of Air Pollution

1.	**Burning fossil fuels** releases gases and chemicals into the air. **Air pollution in the form of carbon dioxide and methane raises the earth's temperature**.
2.	**Smog or ground-level ozone** occurs when emissions from combusting fossil fuels react with sunlight. **Smog can irritate the eyes and throat** and also **damage the lungs.**
3.	Soot, or "particulate matter," is made up of tiny particles of chemicals, soil, smoke, dust, or allergens, in the form of gas or solids that are carried in the air.
4.	Hazardous air pollutants are emitted during gas or coal combustion.
5.	**Sulphur dioxide** is produced from burning coal in thermal power plants.
6.	**Carbon monoxide** is produced from the incomplete burning of carbon-based fuels.
7.	**Chlorofluorocarbons** are released mainly from air conditioning systems and refrigeration.

Major Air Pollutants and Their Sources



Causes of Air Pollution

Carbon monoxide (CO)	✓ It is a colorless, odorless gas that is produced by the incomplete burning of carbon -based fuels including petrol, diesel, and wood. ✓ It is also produced from the combustion of natural and synthetic products such as cigarettes. ✓ It lowers the amount of oxygen that enters our blood. It can slow our reflexes and make us confused and sleepy.
Carbon dioxide (CO2)	✓ Principle greenhouse gas
Chlorofluorocarbons (CFC)	✓ Gases that are released mainly from air-conditioning systems and refrigeration. ✓ When released into the air, CFCs rise to the stratosphere, where they come in contact with few other gases, which lead to a reduction of the ozone layer that protects the earth from the harmful ultraviolet rays of the sun.

Causes of Air Pollution

Lead	✓ Present in petrol, diesel, lead batteries, paints, hair dye products, etc. ✓ Affects children in particular. ✓ Cause nervous system damage and digestive problems and, in some cases, cause cancer.
Ozone	✓ Occurs naturally in the upper layers of the atmosphere. ✓ At-the ground level, it is a pollutant with highly toxic effects. ✓ Vehicles and industries are the major source of ground-level ozone emissions. ✓ Ozone makes our eyes itch, burn, and water. It lowers our resistance to cold and pneumonia.
Nitrogen Oxide (NOX)	✓ Causes smog and acid rain. It is produced from burning fuels including petrol, diesel, and Coal. ✓ Nitrogen oxide can make children susceptible to respiratory diseases in winters.

Causes of Air Pollution

Suspended Particulate Matter (SPM)	✓ Consists of solids in the air in the form of smoke, dust, and vapour that can remain suspended for extended periods ✓ The finer of these particles when breathed in can lodge in our lungs and cause lung damage and respiratory problems.
Sulphur Dioxide (S02)	✓ A gas produced from burning coal, mainly in thermal power plants. ✓ Some industrial processes, such as production of paper and smelting of metals, produce sulphur dioxide. ✓ A major contributor to smog and acid rain. ✓ Sulphur dioxide can lead to lung diseases.
Smog	✓ A combination of the words fog and smoke. Smog is a condition of fog that had soot or smoke in it. Interaction of sunlight with certain chemicals in the atmosphere. ✓ Primary components of photochemical smog is ozone. ✓ Oxides, and sunlight. It is formed when pollutants released from gasoline. ✓ Ozone is formed through a complex reaction involving hydrocarbons, nitrogen diesel-powered vehicles and oil-based solvents react with heat and sunlight from biofuels, the four most serious pollutants are particulates, carbon monoxide, polycyclic organic matter, and formaldehyde.

GOVERNMENT IINITIVES TO COMBAT AIT POLLUTION

- ✓ Notification of National Ambient Air Quality Standards 2009, forecasting 12 pollutants to indicate the level of air quality for protection of public health and sector-specific emission and effluent standards for industries.
- ✓ Setting up of monitoring network for assessment of ambient air quality in different cities.
- ✓ Introduction of cleaner or alternate fuel like CNG, LPG etc and ethanol blending.
- ✓ Launching of National Air Quality Index (AQI).
- ✓ Pass over from BS-IV to BS-VI standards for vehicles by 1st April 2020.
- ✓ Promotion of public transport network
- ✓ Environment audits have been made compulsory for all polluting Industry.

GREENHOUSE GASES AND GLOBAL WARMING

- ✓ Greenhouse gases are another source of air pollution. Greenhouse gases such as carbon dioxide and methane occur naturally in the atmosphere. In fact, they are necessary for life on Earth. They absorb sunlight reflected from Earth, preventing it from escaping into space. By trapping heat in the atmosphere, they keep Earth warm enough for people to live. This is called the greenhouse effect.

- ✓ But human activities such as burning fossil fuels and destroying forests have increased the amount of greenhouse gases in the atmosphere. This has increased the greenhouse effect, and average temperatures across the globe are rising.

GLOBAL WARMING

- ✓ Increase in worldwide average temperatures, caused in part by human activity, is called global warming.
- ✓ Global warming is causing ice sheets and glaciers to melt. The melting ice is causing sea levels to rise at a rate of 2 millimeters (0.09 inches) per year.
- ✓ The rising seas will eventually flood low-lying coastal regions. Entire nations, such as the islands of Maldives, are threatened by this climate change.

Lifetime and Potential of GHG

Gas	GWP (100 Year)	Lifetime (Years)
Carbon Dioxide	1	100
Methane	21	12
Nitrous Oxide	310	120
Hydro fluorocarbons (HFCs)	140 – 11,700	1270
Per fluorocarbons (PFCs)	6,500 – 9,200	8000 – 50000
Sulfur hexafluoride (SF6)	23,900	3200

Pollutants

1. Volatile Organic Compounds

- ✓ The main indoor sources are perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives, and other products.
- ✓ Biological pollutants - It includes pollen from plants, mite, and hair from pets, fungi, parasites, and some bacteria.

2. Formaldehyde

- ✓ Mainly from carpets, particle boards, and insulation foam. It causes irritation to the eyes and nose and allergies.

3. Radon

- ✓ It is a gas that is emitted naturally by the soil. Due to modern houses having poor ventilation, it is confined inside the house and causes lung cancers.

Fly Ash

Ash is Produced Whenever Combustion of Solid Material Takes Place

- ✓ Aluminum Silicate (in large amounts)
- ✓ Silicon dioxide (Si02) and
- ✓ Calcium oxide (CaO)

Fly ash particles are oxide rich and consist of Silica, Alumina, Oxides of Iron, Calcium, and Magnesium and Toxic heavy Metals like Lead, Arsenic, Cobalt, and Coppers.

Fly Ash

- ✓ News- The National Green Tribunal sought a report from the authorities on the current status of Fly ash management and disposal.

- ✓ Fly ash is a fine powder, which is the by-product of burning coal in thermal power plants.

- ✓ Fly ash includes substantial amounts micron sized earth elements of oxides of silica, aluminum and calcium. Element like Arsenic, Boron, Chromium, lead etc. are also found in trace concentrations.

Environmental Concerns Associated With Fly Ash

- ✓ **Fly ash is a major source of PM 2.5, fine, pollution particles, in summer it causes air pollution**
- ✓ It becomes air borne, and gets transported to a radius of 10 to 20 kms. It can settle on water and other surfaces. It can also contaminate water and soil systems.
- ✓ Fly ash contains heavy metals from coal, a large amount of PM 2.5 and black carbon (BC). Proper disposal of fly ash is still not happening in many places.
- ✓ The wet disposal of Fly ash results in leaching of toxic heavy metals in ground water system

Fly Ash : Impacts

- ✓ **On marine environment**: Ingestion, suffocation and entanglement of hundreds of marine species such as seabirds, whales, fishes and turtles.
- ✓ **On Food and Health**: Toxic contaminants accumulate on the surface of plastic materials which when ingested by marine organisms, enter their digestive systems, and overtime accumulate in the food web and leads to the transfer of contaminants between marine species and humans `through consumption of seafood.
- ✓ **Carcinogenic Chemicals present** in the plastic materials interfere with the body's endocrine system, causing developmental, reproductive, neurological, and immune disorders in both humans and wildlife.
- ✓ **On Tourism**: Plastic waste damages the aesthetic value of tourist destinations, leading to decreased tourism related incomes and major economic costs related to the cleaning and maintenance of the sites.

Fly Ash : Policy Measures of MoEF

- ✓ **The Ministry of Environment and Forests vide its notification in 2009, has made it mandatory to use Fly Ash based products in all construction projects, road embankment works and low lying land filling works within 100 kms radius of Thermal Power Station.**

- ✓ To use Fly Ash in mine filling activities within 50 kms radius of Thermal Power Stations

- ✓ **Arresters**: These are used to separate particulate matters from contaminated air.

- ✓ **Scrubbers**: These are used to clean air for both dusts and gases by passing it through a dry or wet packing material.

Fly Ash : Government Initiatives

National Air Quality Monitoring Programme (NAMP)

✓ In India, the **Central Pollution Control Board (CPCB)** has been executing a nationwide programme of ambient air quality monitoring known as **National Air Quality Monitoring Programme (NAMP)**.

(i) To determine status and trends of ambient air quality.

(ii) To ascertain the compliance of NAAQS.

(iii) to identify non-attainment cities

(iv) to understand the natural process of cleaning in the atmosphere; and

(v) to undertake preventive and corrective measures.

Fly Ash : Government Initiatives

National Air Quality Monitoring Programme (NAMP)

- ✓ Annual average concentration of SOx levels are within the prescribed **National Ambient Air Quality Standards (NAAQS)**.

- ✓ **National Ambient Air Quality Standards (NAAas)** were notified in the year 1982, duly revised in 1994 based on health criteria and land uses.

- ✓ The NAAQS have been revisited and revised in November 2009 for 12 pollutants, which include, Sulphur dioxide (502), nitrogen dioxide (NO2), particulate matter having size less than 10 micron.

- ✓ (PM 10),particulate matter having size less than 2.5micron (PM2.5), ozone, lead, carbon monoxide (CO), arsenic, nickel, benzene, ammonia, and. Benzopyrene

Effects of Air Pollution

Ocean Acidification

- ✓ **Ocean acidification is a direct consequence of increased human-induced carbon dioxide (CO2) concentrations in the atmosphere. CO2 dissolves in sea water it forms carbonic acid, thereby decreasing the ocean's pH, leading to a suite of changes collectively known as ocean acidification**
- ✓ ✓ It has the potential to change marine ecosystems and impact many ocean-related benefits to society
- ✓ Changes in species growth and reproduction, as well as structural and functional alterations in ecosystems, will threaten food security, harm fishing industries and decrease natural shoreline protection.
- ✓ It will also increase the risk of inundation and erosion in low-lying areas, thereby hampering climate change adaptation and disaster risk reduction efforts.
- ✓ **Chlorofluorocarbons (CFCs)** damage the ozone layer, a region in Earth's upper atmosphere. The ozone layer protects Earth by absorbing much of the sun's harmful ultraviolet radiation. When people are exposed to more ultraviolet radiation, they are more likely to develop skin cancer, eye diseases, and other illnesses.

Acid Rain

- ✓ Normally rain water has a pH of 5.6 due to the presence of H+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$$H_2O\ (l) + CO_2\ (g)\ H_2CO_3\ (aq)$$

$$H_2CO_3\ (aq) H + HCO_3 -\ (aq)$$

- ✓ When the pH of the rain water drops below 5.6, it is called acid rain.

- ✓ It refers to the ways in which acid from the atmosphere is deposited on the earth's surface. Oxides of nitrogen and sulphur which are acidic in nature can be blown by wind along with solid particles in the atmosphere and finally settle down either on the ground as dry deposition or in water, fog and snow as wet deposition

Acid Rain

- ✓ Acid rain is a byproduct of a variety of human activities that emit the oxides of sulphur and nitrogen in the atmosphere.

Causes of Acid Rain

- ✓ SO_2 and NO_2 after oxidation and reaction with water are major contributors to acid rain, because polluted air usually contains particulate matter that catalyse the oxidation.

- ✓ The burning of fossil fuels (which contain sulphur and nitrogenous matter) such as coal and oil in power stations and furnaces or petrol and diesel in motor engines produces sulphur dioxide and nitrogen oxides.

Sources of Acid Rain

Compound	Natural Sources	Anthopogenic Sources
Sulphur Dioxide	✓ Volcanoes ✓ Oceans ✓ Decomposition of Organic Matters	✓ Fossil Fuel burning ✓ Industrial Process ✓ Thermal Power Plants based on cole
Nitrogen	✓ Volcanos ✓ Lightening ✓ Decomposition of Organic ✓ Forest Fires	✓ Fossil fuel burning ✓ Biomass burning ✓ Power Plants based on coal
Formic Acid	✓ Forest Fires	✓ Biomass burning
Carbon Dioxide	✓ Respiration ✓ Decomposition	✓ Fossil fuel burning ✓ Industrial Process
Carbon Monoxide	✓ Isoprene emission by Plants	✓ Biomass burning ✓ Industrial sources

Types of Acid Deposition

✓ **Based on the moisture content acid deposition can be classified as**

Wet Deposition	Dry Deposition
✓ Acid chemical are blown into areas where Atmospheric condition are wet. Eg: Rain, Snow, fog act as source of Wet acid deposition.	✓ Acid chemical are blown into area where Atmospheric condition are dry. Eg: dust particles, pollen grains act as locus for Dry acid deposition
✓ Wet form of acid deposition is common in region of high moisture like East margin of Tropical region, west margin of temperate region and Polar region.	✓ Wet form of acid deposition is common in west margin of Tropical region and east margin of temperate region.

Acid Rain : Impact

- ✓ **Effects of Acid Rain on Fish and Wildlife**: The ecological effects of acid rain are most clearly seen in aquatic environments, such as streams, lakes, and marshes where it can be harmful to fish and other wildlife.

- ✓ As it flows through the soil, acidic rain water can leach aluminum from soil clay particles and then flow into streams and lakes.

- ✓ The more acid that is introduced to the ecosystem, the more aluminum is released.

- ✓ Some types of plants and animals are able to tolerate acidic waters and moderate amounts of aluminum. Others, however, are acid-sensitive and will be lost as the pH declines.

- ✓ **Effects of Acid Rain on Plants and Trees**: Dead or dying trees are a common sight in areas effected by acid rain.

Acid Rain : Impact

- ✓ Acid rain also **removes minerals and nutrients from the soil that trees need to grow**.

- ✓ **Effects of Acid Rain on Materials**: Not all acidic deposition is wet. Sometimes dust particles can become acidic as well, and this is called dry deposition.

- ✓ The acidic particles corrode metal and cause paint and stone to deteriorate more quickly. They also dirty the surfaces of buildings and other structures such as monuments.

- ✓ The Taj Mahal in India has been affected by acid rain.

Acid Rain : Impact

- ✓ **Effects on Human Health**: When the pollutants that cause acid rain —S02 and NOX, as well as sulfate and nitrate particles— are in the air, they can be harmful to humans.

- ✓ SO2 and NOX react in the atmosphere to form fine sulfate and nitrate particles that people can inhale into their lungs.

- ✓ It corrodes water pipes resulting in the leaching of heavy metals such as iron, lead and copper into the drinking water.

- ✓ Many scientific studies have shown a relationship between these particles and effects on heart function, such as heart attacks resulting in death for people with increased heart disease risk, and effects on lung function, such as breathing difficulties for people with asthma.

Indoor Air Pollution

- ✓ **Indoor air pollution is caused by burning solid fuel sources — such as firewood, crop waste, and dung —for cooking and heating. The burning of such fuels, particularly in poor households, results in air pollution that leads to respiratory diseases which can result in premature death.**

- ✓ Air pollution is the cause of 7 million premature deaths worldwide. Out of this 7 million, 2.6 million premature deaths are caused by indoor air pollution.

- ✓ **Characteristics**: IAP impacts are more prominent among low Socio Demographic Index (SDI) countries, within a country, the IAP is more likely to impact poor & rural households compared to affluent and urban households.

- ✓ IAP affects women and children more than men.

- ✓ 6% of deaths in low-income countries are attributed to indoor air pollution.

Indoor Air Pollution : Sources

Sources of Indoor Air Pollution

- ✓ Fuel-burning combustion appliances
- ✓ Building materials and furnishings
- ✓ Products for household cleaning and maintenance, personal care, or hobbies
- ✓ Central heating and cooling systems and humidification devices
- ✓ Excess moisture

Outdoor sources such as:

- ✓ Radon
- ✓ Pesticides
- ✓ Outdoor air pollution.

Indoor Air Pollution

Short Term Effects

- ✓ Some health effects may show up shortly after a single exposure or repeated exposures to a pollutant.
- ✓ These include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. Such immediate effects are usually short-term and treatable.
- ✓ Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution, if it can be identified.
- ✓ Soon after exposure to some indoor air pollutants, symptoms of some diseases such as asthma may show up, be aggravated or worsened.

Long Term Effects

- ✓ Exposure to indoor air pollutants can lead to a wide range of adverse health outcomes in both children and adults, from respiratory illnesses to cancer to eye problems.
- ✓ Members of households that rely on polluting fuels and devices also suffer a higher risk of burns, poisonings, musculoskeletal injuries and accidents.

Measures

- ✓ Spreading awareness among people about the issue and the serious threat IAP poses to their health and wellbeing.
- ✓ **Promoting use of cleaner energy sources such as gobar gas, LPG, etc. is required.**
- ✓ Modification of design of cooking stove to make fuel efficient, smokeless and have an exit (e.g., chimney) for indoor pollutants.
- ✓ Improvement in ventilation: measures such as a window above the cooking stove and cross ventilation though doors should be instituted.
- ✓ Intersectoral coordination and global initiative

Status in India and Government Steps

- ✓ As per Census 2011, about 65.9 per cent of households depend on solid biomass, including firewood, crop residue and cow dung as primary fuel for cooking in India.
- ✓ The Ministry of New and Renewable Energy (MNRE) is implementing following programmes to reduce dependence upon traditional biomass cooking.
- ✓ The Unnat Chulha Abhiyan: It was launched in 2014 for promotion of improved biomass cook stove
- ✓ National Biogas and Manure Management Programme (NBMMP) for setting up of family type household biogas plants.
- ✓ Promoting solar cookers to reduce the indoor air pollution.
- ✓ **Pradhan Mantri Ujjwala Yojana (PMUY):** It was Launched in 2016 with a motto 'Swachha Indhan, behtar Jeevan' (Clean fuel, better life) by the Ministry of Petroleum and Natural Gas to safeguard the health of women & children by providing them with clean cooking fuel through LPG.

SMOG

- ✓ **SMOG**: The word smog is derived from **smoke and fog**. It is caused by the burning of large amounts of coal, vehicular emission and industrial fumes(Primary pollutants), that react in the atmosphere with sunlight to form secondary pollutant.
- ✓ This is the most common example of air pollution that occurs in many cities throughout the world.

- ✓ This is the most common example of air pollution that occurs in many cities throughout the world

SMOG

There are two types of Smog

Classical Smog

- ✓ Classical smog occurs in cool humid climate. It is a mixture **of smoke, fog** and **Sulphur dioxide.** Chemically it is a reducing mixture and so it is also called as **reducing smog**.

Photochemical Smog

- ✓ Photochemical smog occurs in **warm, dry and sunny climate.** The main components of the photochemical smog result from the action of sunlight on unsaturated hydrocarbons and nitrogen oxides produced by automobiles and factories.
- ✓ Photochemical smog has high concentration of oxidising agents and is, therefore, called as **oxidising smog**.
- ✓ These secondary pollutant combine with primary emission to form photochemical smog
- ✓ Smog contains soot particulates like smoke, sulphur dioxide, nitrogen dioxide and other components

SMOG

- ✓ When fossil fuels are burnt, a variety of pollutants are emitted into the earth's troposphere.
- ✓ Two of the pollutants that are emitted are hydrocarbons (unburnt fuels) and nitric oxide (NO).
- ✓ When these pollutants build up to sufficiently high levels, a chain reaction occurs from their interaction with sunlight in which NO is converted into nitrogen dioxide (NO_2).
- ✓ This NO_2 in turn absorbs energy from sunlight and breaks up into nitric oxide and free oxygen atom.

SMOG

Effects of Photochemical Smog

- ✓ Photochemical smog causes serious health problems. Both ozone and PAN act as powerful eye irritants.
- ✓ Ozone and nitric oxide irritate the nose and throat and their high concentration causes headache, chest pain, dryness of the throat, cough and difficulty in breathing.
- ✓ Photochemical smog leads to cracking of rubber and extensive damage to plant life.
- ✓ It also causes corrosion of metals, stones, building materials, rubber and painted surfaces

How to control Photochemical Smog

- ✓ Many techniques are used to control or reduce the formation of photochemical smog. If we control the primary precursors of photochemical smog, such as NO2 and hydrocarbons, the secondary precursors such as ozone and PAN, the photochemical smog will automatically be reduced.
- ✓ Usually catalytic converters are used in the automobiles, which prevent the release of nitrogen oxide and hydrocarbons to the atmosphere.
- ✓ Certain plantsg., Pinus, Juniparus, Quercus, Pyrus and Vitis can metabolise nitrogen oxide and therefore, their plantation could help in this matter.

SMOG

Smog Tower	✓ Smog Towers are air purification structures that are designed to work as air purifiers. They are fitted with multiple air purifiers. These purifiers cleanses air as it passes through them. ✓ It is a successful project and China has fitted two smog towers in the city of Beijing and Xi'an.
Anti Smog Gun	✓ The anti-smog gunis a canon that sprays atomized water 50 metres into the air to bring down suspended pollutants. ✓ The atomised water sprayed from the gun helps in bringing down the minute particles,which constitute the PM 2.5, the main pollutant.

Gothenburg Protocol

- ✓ It is one of the Eight Protocols under UNECE Convention on Long Range Transboundary Air Pollution (CLRTAP or Air convention). It was adopted in 1999 to abate Acidification, Eutrophication and Ground level Ozone.
- ✓ The revised Protocol (2012) sets national emission ceilings (up to 2020) for four pollutants: sulphur (S02), nitrogen oxides (NOx), volatile organic compounds (VOCs) and ammonia (NH3).
- ✓ It is also the first binding agreement to include emission reduction commitments for fine particulate matter.
- ✓ Also, black carbon (or soot), a short-lived climate pollutant is included within particulate matter for policymaking.
- ✓ Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce have to make the biggest cuts.

SMOG

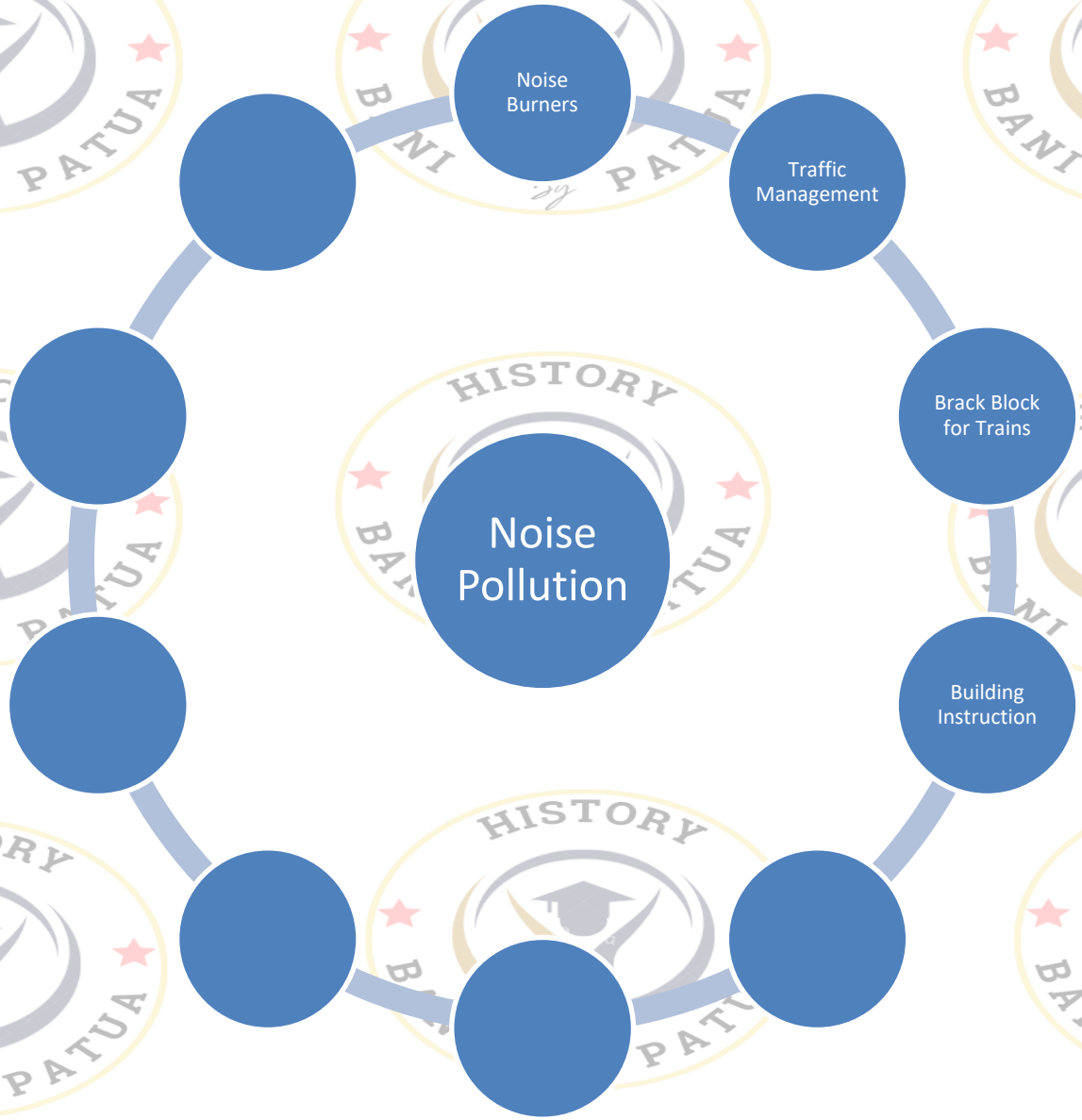
Classical Smog	Photochemical Smog
✓ This type of smog is **first observed in 1952** in **London**.	✓ This type of smog was **first observed in 1943** in **Los Angeles.**
✓ It involves smoke and fog (smog)	✓ The word smog is misnomer here as it **does not involve any smoke or fog.**
✓ It is formed due to presence of SO2 and humidity in the air which combine to form H2SO4 (Sulphuric acid) fog which deposits on the particulates. Therefore London smog is also known as Sulfurous smog.	It is formed due to photochemical reaction (presence of sunlight) taking place when air contains NO2 and hydrocarbons forming toxic chemicals like peroxyacylnitrates (PAN), Ozone etc. Los Angeles smog is also known as Photochemical smog.
✓ It is reducing in character Chemically it is **reducing mixture and hence is called reducing smog.**	✓ It is oxidizing in character. It has high concentration of **oxidizing** agents hence it is known as **oxidizing smog**.
✓ It causes bronchitis irritation, i.e., problem in the lungs.	✓ It causes irritation in the eyes.
✓ It is formed in the months of winter particularly in the morning hours when temperature is low.	✓ It is formed in the months of summer during afternoon when there is bright sunlight so that photochemical reactions can take place.
✓ **Reduction**: in simple terms addition of **hydrogen.**	✓ **Oxidation**: **addition of oxygen**

NOISE POLLUTION

Noise Pollution

- ✓ Sound is measured in decibels (dB). An increase of about 10 dB is approximately double the increase in loudness.
- ✓ A person's hearing can be damaged if exposed to noise levels over 75 dB over a prolonged period of time.
- ✓ The World Health Organization recommends that the sound level indoors should be less than 30 dB. Noise is measured in term of decibels (dB), as per WHO (World Health Organization) has prescribed optimum noise level as 45 dB by day to 35 dB at night.
- ✓ Unwanted or excessive sound that can have deleterious effects on human health and environmental quality
- ✓ Noise pollution is commonly generated inside many industrial facilities and some other workplaces, but it also comes from highway, railway, and airplane traffic and from outdoor construction activities

Sources of Noise Pollution



Noise Pollution : Impact

Hypertension:	✓ It is a direct result of noise pollution caused elevated blood levels for a longer period of time.
Hypertension	✓ It can be directly caused by noise pollution, whether listening to loud music in your headphones or being exposed to loud drilling noises at work, heavy air or land traffic, or separate incidents in which noise levels reach dangerous intervals, such as around140 dB for adult or 120 dB for children.
Sleep disturbances	✓ Sleep disturbances are usually caused by constant air or land traffic at night, and they are a serious condition in that they can affect everyday performance and lead to serious diseases. .
Child development	✓ Children appear to be more sensitive to noise pollution, and a number of noise-pollution-related diseases and dysfunctions are known to affect children, from hearing impairment to psychological and physical effects. .

Noise Pollution : Impact

Cardiovascular dysfunctions	✓ Elevated blood pressure caused by noise pollution, especially during the night, can lead to various cardiovascular diseases.
Sleep disturbances	✓ Psychological dysfunctions and noise annoyance: Noise annoyance is, in fact, a recognized name for an emotional reaction that can have an immediate impact. .
	✓ .

Effects of Noise Pollution on Wildlife and Marine Life

- ✓ Our oceans are no longer quiet. Thousands of oil drills, sonars, seismic survey devices, coastal recreational watercraft and shipping vessels are now populating our waters, and that is a serious cause of noise pollution for marine life.

- ✓ Whales are among the most affected, as their hearing helps them orient themselves, feed and communicate. Noise pollution thus interferes with cetaceans' (whales and dolphins) feeding habits, reproductive patterns and migration routes, and can even cause hemorrhage and death.

- ✓ Other than marine life, land animals are also affected by noise pollution in the form of traffic, firecrackers etc., and birds are especially affected by the increased air traffic.

Noise Pollution

Measures to Control Noise Pollution

- ✓ Strict imposition of noise limit over loudspeakers and automobiles.
- ✓ Restrictions on burning firecrackers and honking in silent areas.
- ✓ Construction of green mufflers by planting trees
- ✓ Proper use of noise control equipment such as earplug, noise cancelling headphones etc.
- ✓ Job rotation so as to reduce exposure time in noisy industrial places.

Laws Governing Noise Pollution

- ✓ Air (Prevention and Control of Pollution) Act, 1981: It includes 'Noise' as an air pollutant.
- ✓ Noise Pollution (Regulation and Control) Rules, 2000: It defines and regulates noise pollution and its sources.
- ✓ Environment (Protection) Rules, 1986: It prescribes noise standards for motor vehicles, air- conditioners, refrigerators, diesel generators and certain types of construction equipment.
- ✓ Noise emanating from industry is regulated by State Pollution Control Boards / Pollution Control Committees (SPCBs / PCCs) for states / Union territories under the Air (Prevention and Control of Pollution) Act, 1981.

TERM

Dissolved Oxygen	✓ Dissolved Oxygen (DO) is a measure of the amount of free oxygen available in river systems. Presence of organic and inorganic wastes in water decreases the dissolved oxygen content of the water. DO below 8 ppm (Parts Per Million) indicates pollution and below 4 ppm indicates heavy pollution. In unpolluted water, DO should be about 14 ppm.
Biological Oxygen Demand (BOD)	✓ BOD is the amount of oxygen that will be consumed by bacteria or other aerobic microorganisms while decomposing organic matter under aerobic conditions. As tested, it is expressed in milligrams of oxygen consumed per liter of sample during a fixed incubation period. It is generally used as an indicator of the amount of organic pollution in a water sample. So, the BOD in polluted waters will generally be higher than in clean water. The higher value of BOD indicates low DO content of water. Since BOD is limited to biodegradable materials only. Therefore, it is not a reliable method of measuring pollution in water.

TERM

Chemical Oxygen Demand (COD)	✓ COD is a slightly better mode used to measure pollution load in water. COD measures the amount of oxygen that will be consumed by the chemical breakdown, or oxidation (degeneration) of organic pollutants in water. The measurement of COD is also expressed in milligrams per liter under a specific oxidizing agent, temperature and time and can be completed in hours. This measurement looks for the oxygen consumed by a specific chemical oxidation process, and is not a substitute for BOD, or DO. It also is an indicator of the amount of organic pollution in a water sample. The COD is less specific than BOD as it measures the oxygen consumption for any pollutant that can be chemically oxidized, versus BOD which is only that portion which is biodegradable.
Invasive species	✓ Invasive plant species water hyacinth aquatic weed, also called 'Terror of Bengal' destroy micro environment to their advantage by producing allelochemicals which cause the destruction of native species and local biodiversity.

Noise Pollution

- ✓ **Noise Level Monitoring** - Noise Pollution (Control and Regulation) Rules, 2000 define ambient noise levels for various areas as follows -

(i) Industrial Area- 75DB to 70Db (Day time-6 am to 10 pm and night time 10pm to 6am..75 is day time and 70 is night time)

(ii) Commercial Area- 65 to 55

(iii) Residential Area- 55 to 45

Silence Zone- 50 to 40

- ✓ **The Government of India on Mar 2011 launched a Real time Ambient Noise Monitoring Network (2011, Lunched Govt of India).**

Noise Pollution

✓ **Noise Level Monitoring** - Noise Pollution (Control and Regulation) Rules, 2000 define ambient noise levels for various areas as follows -

S/N	Area Code	Category of Area	Limits in dB (A) in between	
			Day Time 6 a.m. & 9 p.m.	Night Time (9 p.m. & 6 a.m.
1	A	Industrial Area	75	70
2	B	Commercial Area	65	55
3	C	Residential Area	55	45
4	D	Silence Zone	50	40

* The limit in dB denotes the time-weighted average of the level of sound in decibels on Scale A which is relatable to human hearing.

Noise Pollution

- ✓ **Noise Level Monitoring** - Noise Pollution (Control and Regulation) Rules, 2000 define ambient noise levels for various areas as follows -
- ✓ **The Government of India on Mar 2011 launched a Real time Ambient Noise Monitoring Network**.
- ✓ Under this network in phase- 1, five Remote Noise Monitoring Terminals each have installed in different noise zones in seven metros (Delhi, Hyderabad, Kolkata, Mumbai, Bangalore, Chennai and Lucknow).
- ✓ In Phase II another 35 monitoring stations will be installed in the same seven cities.
- ✓ Phase III will cover installing 90 stations in 18 other cities.
- ✓ Phase-II cities are Kanpur, Pune, Surat, Ahmedabad, Nagpur, Jaipur, Indore, Bhopal, Ludhiana, Guwahati, Dehradun, Thiruvananthapuram, Bhubaneswar, Patna, Gandhinagar, Ranchi, Amritsar and Raipur.

Noise Pollution

- ✓ Silence Zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other t area declared as such by a competent authority.

- ✓ Polluted water not only does this spell disaster for aquatic ecosystems, the pollutants also seep through and reach the groundwater, which might end up in our households as contaminated water we use in our daily activities, including drinking.

- ✓ The United Nations estimates that 4,000 children die every day from drinking dirty water.

Water Pollution

Water Pollution

- ✓ Addition of certain substances to the water such as **organic, inorganic, biological, radiological, heat, which degrades the quality of water** so that it becomes unfit for use.

- ✓ Putrescibility is the process of decomposition of organic matter present in water by microorganisms using oxygen.

- ✓ Water having **DO (dissolved oxygen)** content below **8.0 mg/L** may be considered as contaminated. Water having DO content below. **4.0 mg/L is considered to be highly polluted**.

- ✓ **Water pollution by organic wastes is measured** in terms of **Biochemical Oxygen Demand-(BOD)**. BOD is the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water.

- ✓ **Chemical Oxygen Demand (COD)** is a **slightly better mode** used to measure pollution load in water. It is the measure of oxygen equivalent to the requirement of oxidation of total organic matter **(i.e. biodegradable and non- biodegradable)** present in water. .

Water Pollution

- ✓ A crippling deformity called **Minamata disease** due to consumption of fish captured from **Mercury** contaminated Minamata Bay

- ✓ Water contaminated with **Cadmium** can cause **itai-itai disease** also called ouch-ouch disease (a painful disease of bones and joints) and **cancer of lungs and liver**

- ✓ The compounds of **lead** cause **anaemia, headache, loss of muscle power and bluish line around** the gum. .

- ✓ Excess nitrate in drinking water reacts with hemoglobin to form non -functional methaemoglobin, and impairs oxygen transport. This condition is called methemoglobinemia or blue baby syndrome.

- ✓ Over exploitation of ground water may lead to leaching of arsenic from soil and rock sources and contaminate ground water. Chronic exposure to arsenic causes black foot disease. It also causes diarrhoea, -peripheral neuritis, hyperkeratosis and also lung and skin cancer.

The Key Health Problems caused by Water Pollution

The key Health Problems Caused by Water Pollution

Diarrhea

Vomiting

Typhoid

Diphtheria

Hepatitis

Kidney Damage

Nerve Disorders

Skin Lesions

Causes of Water Pollution

Industrial Effluents	✓ Industrial effluents have a complex nature of pollutants and include organic and inorganic substances like pharmaceutical residues, dyes, and metals, requiring treatment before discharge in wastewater streams.
Social and Religious Practices	✓ Among various types of anthropogenic actions religious activities like immersion of flour, oil, soap, ash, detergents, floral offerings, and mass bathing are also one of the important causes that affect the water quality of a water body. ✓ The religious activities are deeply rooted in its cultural heritage; millions of people take holy bath and perform religious activities
Use of Detergents and Fertilizer	✓ .Water pollution by chemicals (such as detergents) is a big concern in the global context. ✓ Many laundry detergents contain approximately **35 percent to 75 percent phosphate** salts. Over enrichment of phosphate can cause the water body to become choked with algae and other plants. ✓ **Eutrophication deprives the water of available oxygen, causing the death of other organisms**.

Causes of Water Pollution

Agriculture Runoffs Use of Insecticides and Pesticides	✓ Agricultural Runoff (non-point source) is water from farm fields due to irrigation, rain, or melted snow that flows over the earth that can absorb into the ground, enter bodies of waters or evaporate. ✓ This runoff can contain pesticides, sediment (soil particles), nutrients (phosphorus, nitrogen and potassium from fertilizers) and metals, which can contaminate sources of water.
Mining Activities	✓ **Mining activities emit several metal waste and sulphides from the rocks and is harmful for the water**. ✓ Acid mine drainage causes the acidity of water, which in turn disturb the chemical composition of water source by dissolving and freeing some harmful substances .
Marine Dumping	✓ In some countries the garbage produce by each household in the form of paper, aluminum, rubber, glass, plastic, food if collected and deposited into the sea. .

Causes of Water Pollution

Accidental Leakage Marine Pollution	✓ Oil spill pose a huge concern as large amount of oil enters into the sea which does not dissolve with water; there by opens problem for local marine wildlife such as fish, birds and sea otters etc. ✓ For example, a ship carrying large quantity of oil may spill oil if met with an accident and can cause varying damage to species in the ocean depending on the quantity of oil spill, size of ocean, toxicity of pollutant.
Burning of Fossil Fuels	✓ Fossil fuels like coal and oil when burnt produce substantial amount of **ash** in the atmosphere. The **particles which contain toxic chemicals (often of sulfur, which is present in coal) when mixed with water vapor result in acid rain**. .
Facilities Handling Radioactive Materials	✓ The element that is used in production of **nuclear energy** is **Uranium** which is a highly toxic chemical. ✓ Nuclear waste can have serious environmental hazards if not disposed-off properly..

Causes of Water Pollution

Urban Development and Run Off	✓ Oil spill pose a huge concern as large amount of oil enters into the sea which does not dissolve with water; there by opens problem for local marine wildlife such as fish, birds and sea otters etc. ✓ For example, 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

Under Ground Water Pollution

Under Ground Water Pollution

Groundwater contamination occurs when man-made products such as gasoline, oil, road salts and chemicals get into the groundwater and cause it to become unsafe and unfit for human use.

- ✓ Materials from the land's surface can move through the soil and end up in the groundwater. For example, pesticides and fertilizers can find their way into groundwater supplies over time.

- ✓ Road salt, toxic substances from mining sites, and used motor oil also may seep into groundwater.

- ✓ In addition, it is possible for untreated waste from septic tanks and toxic chemicals from underground storage tanks and leaky landfills to contaminate groundwater.

Factors Affection Ground Water Pollution

The extent of Ground Water Pollution depands on the following factors :

- ✓ 1. Rainfall Pattern
- ✓ 2. Depth of Water Table
- ✓ 3. Distance from the Source of Contamination
- ✓ 4. Soil Properties such as Texture tructure and Filtration Rate

Causes for Ground Water Contamination

- ✓ Discharge of toxic elements from industries and landfills and diffused sources of pollution like fertilizers and pesticides over the years has resulted in high levels of contamination of groundwater with the level of nitrates exceeding permissible limits in more than 50% districts in India.

- ✓ **Industries** - Manufacturing and other chemical industries require water for processing and cleaning purposes. This used water is recycled back to water sources without proper treatment. Also industrial waste is dumped in certain areas, the seepage of which results in groundwater contamination.

- ✓ **Agriculture** - the fertilizers, pesticide and other chemicals used in growing plants contaminate groundwater.

- ✓ **Residential Areas** - These generate pollutants (microorganisms and organic compounds) for groundwater contamination

- ✓ **Mining** - Mine drain discharge, oilfield spillage, sludge and process water also contaminate groundwater

- ✓ **Coastal Areas** - Saltwater intrusion increases the salinity of groundwater in nearby areas.

Soil Pollution

Soil Pollution

- ✓ Industrial waste includes chemicals such as mercury, lead, copper, zinc, cadmium, cyanides, thiocynates, chromates, acids, alkalies, organic substances etc.

- ✓ **Four R's:- (1) Refuse, (2) Reduce, (3) Reuse, and (4) Recycle.**

- ✓ Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. .

- ✓ In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of the contaminants in soil exceed the levels that should naturally be present.

- ✓ The soil contamination can occur due to the presence of chemicals such as pesticides, herbicides, ammonia, petroleum hydrocarbons, lead, nitrate, mercury, naphthalene, etc in an excess amount.

Soil Pollution

Anthropogenic (Man-Made) Causes

Natural Causes

- ✓ Anthropogenic (man-made) soil pollution originates in several types of processes, some deliberate (industrial) and some accidental. Human-caused soil pollution can work in conjunction with natural processes to increase the toxic contamination levels in the soil.
- ✓ **Accidental spills and leaks** during storage, transport or use of chemicals (e.g. leaks and spills of gasoline and diesel at gas stations); -Foundry activities and manufacturing processes that involve furnaces or other processes resulting in the possible dispersion of contaminants in the environment;
- ✓ **Mining activities** involving the crushing and processing of raw materials, for instance, heavy metals, emitting toxic substances;
- ✓ **Construction activities**;
- ✓ **Agricultural activities** involving the diffusion of herbicides, pesticides and/or insecticides and fertilizers; 'Transportation activities, releasing toxic vehicle emissions.
- ✓ **Chemical waste dumping**, whether accidental or deliberate — such as illegal dumping; 'The storage of waste in landfills, as the waste products may leak into groundwater or generate polluted vapors
- ✓ **Cracked paint chips** falling from building walls, especially lead-based paint.

THERMAL POLLUTION

Thermal Pollution

- ✓ The main sources of thermal pollution are the thermal and nuclear power plants.
- ✓ Power plants —thermal and nuclear, chemical and other industries use a lot of water for cooling purposes, and the used hot water is discharged into rivers, streams or oceans.
- ✓ Discharge of hot water may increase the temperature of the receiving water by 10 to 15 °C above the ambient water temperature. This is thermal pollution.
- ✓ Increase in water temperature decreases dissolved oxygen in the water.
- ✓ One of the best methods of reducing thermal pollution is to store the hot water in cooling ponds, allow the water to cool before releasing into any receiving water body.

AGRICULTURAL POLLUTION

Agricultural Pollution

- ✓ **Around the world, agriculture is the leading cause of water degradation**
- ✓ Agricultural pollution is the top source of contamination in rivers and streams, the second-biggest source in wetlands, and the third main source in lakes. It's also a major contributor of contamination to estuaries and groundwater.
- ✓ Every time it rains, fertilizers, pesticides, and animal waste from farms and livestock operations wash nutrients and pathogens—such bacteria and viruses—into our waterways.
- ✓ Nutrient pollution, caused by excess nitrogen and phosphorus in water or air, can cause algal blooms, a toxic soup of blue-green algae that can be harmful to people and wildlife.

RADIO ACTIVE POLLUTION

Radio Active Pollution

- ✓ Non-ionising radiations affect only those components which absorb them and have low penetrability. They include short-wave radiations such as ultraviolet rays, which forms a part of solar radiation. Sunburns is due to these radiation

- ✓ Ionising radiations have high penetration power & cause breakage of macro molecules They include X-rays, cosmic rays and atomic radiations -(radiations emitted by radioactive elements

- ✓ Alpha particles, can be blocked by a piece of paper and human skin. Beta particles can penetrate through skin, while can be blocked by some pieces of glass.

- ✓ Gamma rays can penetrate easily to human skin and damage cells on its way through, and metal.

- ✓ Reaching far, and can only be blocked by a very thick, strong, massive piece of concrete radium-224, uranium-238, thorium-232, potassium-40, carbon-1A, etc.

- ✓ The nuclear arms use uranium-235 and plutonium-239 for fission and hydrogen or lithium as fusion material. The radio nuclides with long half-time are the chief source of environmental radioactive pollution.

Radio Active Pollution

- ✓ It's generated by uranium mining, nuclear power plants, and the production and testing of military weapons, as well as by universities and hospitals that use radioactive materials for research and medicine.
- ✓ Radioactive waste can persist in the environment for thousands of years, making disposal a major challenge. Accidentally released or improperly disposed of contaminants threaten groundwater, surface water, and marine resources.
- ✓ Gamma rays can penetrate easily to human skin and damage cells on its way through, and metal.
- ✓ Reaching far, and can only be blocked by a very thick, strong, massive piece of concrete radium-224, uranium-238, thorium-232, potassium-40, carbon-14, etc.

Sources of Radio Active Raadiations

- ✓ We say that the planned change required is change in people **when development is required in these following areas**

Natural Sources:

- ✓ They include cosmic rays from space and terrestrial radiations from radio-nuclides present in earth's crust such as radium-224, uranium-238, thorium-232, potassium-40, carbon-14 etc.

Man-Made Sources:

- ✓ Nuclear power plants
- ✓ Nuclear weapons
- ✓ Transportation of nuclear material
- ✓ Disposal of nuclear waste
- ✓ Uranium mining

Radiation therapy

E-WASRE AND SOLID WASTE

E-Waste

- ✓ E-waste is not hazardous if it is stocked in safe storage or recycled by scientific methods or transported from one place to the other in parts or in totality in the formal sector. The e-waste can be considered hazardous if recycled by primitive methods

- ✓ Survey was carried out by the Central Pollution Control Board (CPCB) during 2005

- ✓ In India, among top ten cities; Mumbai ranks first in generating e-waste followed by Delhi, Bangalore, Chennai, Kolkata, Ahmadabad, Hyderabad, Pune, Surat and Nagpur.

Solid Waste

- ✓ The discarded (abandoned or considered waste-like) materials in irrigation return flows or industrial discharges, Conventional plastics have been associated with reproductive problems in both.
- ✓ Does not include solid or dissolved materials in domestic sewage, or solid or dissolved humans and wildlife.
- ✓ Dioxin (highly carcinogenic and toxic) by-product of the manufacturing process is one of the chemicals believed to be passed on through breast milk to the nursing infant.
- ✓ Burning of plastics, especially PVC releases this dioxin and also furan into the atmosphere.
- ✓ Pyrolysis-It is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels.

Types of Solid Waste

- ✓ **Hazardous Waste**: "Hazardous waste" means any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances.

- ✓ **Municipal Solid Waste (MSW):** It consists of household waste, construction and demolition debris (CnD), sanitation residue, and waste from streets, generated mainly from residential and commercial complexes.

- ✓ As per the MoEF it includes commercial and residential waste generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes

- ✓ **Industrial Solid Waste (ISW):** In a majority of cases it is termed as hazardous waste as they may contain toxic substances, are corrosive, highly inflammable, or react when exposed to certain things e.g. gases.

- ✓ **Biomedical waste or hospital waste**: It is usually infectious waste that may include waste like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc., usually in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. These can be a serious threat to human health if not managed in a scientific and discriminate manner.

Waste Manimization Circles (WMC)

- ✓ Helps Small and Medium Industrial Clusters in waste minimization in their industrial plants, assisted by the World Bank with the Ministry of Environment and Forests acting as the nodal ministry.

- ✓ Being implemented with the assistance of National Productivity Council (NPC), New Delhi.

- ✓ Aims to realise the objectives of the Policy Statement for Abatement of Pollution (1992), which states that the government should educate citizens about environmental risks, the economic and health dangers of resource degradation and the real economic cost of natural resources.

Bioremediation

- ✓ The use of microorganisms (bacteria and fungi) to degrade the environmental contaminants into less toxic forms. Phytoremediation is use of plants to remove contaminants from soil and water.

Rhizofiltration →

- ✓ A water remediation technique that involves the uptake of contaminants by plant roots. Used to reduce contamination in natural wetlands and estuary areas.

- ✓ Bioremediation technologies utilize naturally occurring microorganisms, such as bacteria, fungi, and yeast, to degrade hazardous substances into non-toxic or less toxic substances.

OZONE POLLUTION

- ✓ News- Delhi recorded an ozone pollution which is 1.22 times higher than the eight-hour average standard for ozone exposure that is 100 microgram per cubic meter.

Ozone is classified into two types:

Good ozone:
Found in stratosphere, it protects the Earth's surface from dangerous ultraviolet light.

Bad Ozone:
Found in the troposphere (also known as ground level ozone), it is man-made. The released nitrogen oxide (NOx), carbon monoxide (CO) and volatile organic compounds (VOC), (NOx, CO, and VOCs are known as ozone precursors)

Health and Environment Impact of Ozone

- ✓ It is a highly reactive gas, even short-term exposure of an hour is dangerous for those with respiratory conditions and asthma.
- ✓ Breathing ozone can cause chest pain, coughing, throat irritation Land airway inflammation.
- ✓ Increases the risk of respiratory infection and susceptibility to pulmonary inflammation (COPD).
- ✓ Breathing ozone can shorten the life that is premature death. Ozone causes harm to vegetation and ecosystems including forests, parks, wildlife refuges etc.
- ✓ It can cause cardiovascular diseases that inhaling ozone may affect the heart.

Sulphur Dioxide (SO2) Emissions

- ✓ Greenpeace has found that India is the largest emitter of Sulphur dioxide (S02) in the world, contributing more than 15% of global anthropogenic emissions.
- ✓ SO2emissions are a significant contributor to air pollution. High concentrations of SO2 in the air generally lead to the formation of other Sulphur Oxides (SOx).
- ✓ SOx can react with other compounds in the atmosphere to form small particles. These particles contribute to Particulate Matter (PM) pollution.
- ✓ Small particles may penetrate deeply into the lungs and in sufficient quantity can contribute to health problems.
- ✓ The greatest source of SO2 in the atmosphere is the burning of fossil fuels in power plants and other industrial facilities
- ✓ Other sources include industrial processes such as extracting metal from ore, natural sources such as volcanoes, and locomotives, ships and other vehicles and heavy equipment that burn fuel with high sulphur content.

PLASTIC POLLUTION

Plastic Pollution

- ✓ Single-use plastics, often also referred to as disposable plastics, are commonly used for plastic packaging and include items intended to be used only once before they are thrown away or recycled.
- ✓ These include, among other items, grocery bags, food packaging, bottles, straws, containers, stirrers, Styrofoam cups or plates etc.
- ✓ According to Un-Plastic Collective Report, an estimated 8.3 billion tonnes of plastic has been produced since the early 1950s, about 60% of which has ended up either in a landfill or the natural environment
- ✓ India alone generates 9.46 million tonnes of plastic waste every year, around 43% of which comprises single-use plastic
- ✓ India generates close to 26,000 tonnes of plastic a day, according to a CPCB estimate from 2012. Worse, a little over 10,000 tonnes a day of plastic waste remains uncollected.

LIGHT POLLUTION

Light Pollution

- ✓ Light pollution is the presence of anthropogenic and artificial light in the night environment. Excessive light on the retina causes extreme discomfort to the eyes.
- ✓ It is exacerbated by excessive, misdirected or obtrusive use of light, but even carefully used light fundamentally alters natural conditions.
- ✓ It also threatening 30 percent of vertebrates that are nocturnal and over 60 percent of invertebrates that are nocturnal, artificial light also affects plants and microorganisms.
- ✓ Disturbs the reproductive cycles of some animals and loss of biodiversity due to change in predation and migration pattern of wildlife animal.
- ✓ In humans, it disturbs circadian rhythms that regulate hormones and other bodily functions like Psychological Behaviour change
- ✓ Excessive blue light emitted form LEDs directly affects sleep pattern in Human by suppressing the production of the hormone melatonin, which mediates the sleep-wake cycle in humans.

NITROGEN POLLUTION

Nitrogen Pollution

- ✓ In an automobile engine, (at high temperature) when fossil fuel is burnt, dinitrogen and dioxygen combine to yield significant quantities of nitric oxide (NO) and nitrogen dioxide (NO2) as given below

N2 (g) + 02 (g) 2N0(g)
NO reacts instantly with oxygen to give NO2
2N0 (g) + 02 (g) 4 2NO2 (g)
Rate of production of NO2 is faster when nitric oxide reacts with ozone in the stratosphere.
NO (g) + 03 (g) 4 NO2 (g) + 02 (g)

- ✓ The irritant red haze in the traffic and congested places is due to oxides of nitrogen.

- ✓ ligher concentrations of NO2 damage the leaves of plants and retard the rate of photosynthesis.

- ✓ Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children.

Nitrogen Pollution

- ✓ It is toxic to living tissues also. Nitrogen dioxide is also harmful to various textile fibres and metals.

- ✓ Nitrogen compounds running off farmland have led to water pollution problems around the world, while nitrogen emissions from industry, agriculture and vehicles make a big contribution to air pollution.

- ✓ Nitrogen becomes a pollutant when it escapes into the environment and reacts with other organic compounds. It is either released into the atmosphere, gets dissolved in water sources such as rivers, lakes or groundwater, or remains in the soil.

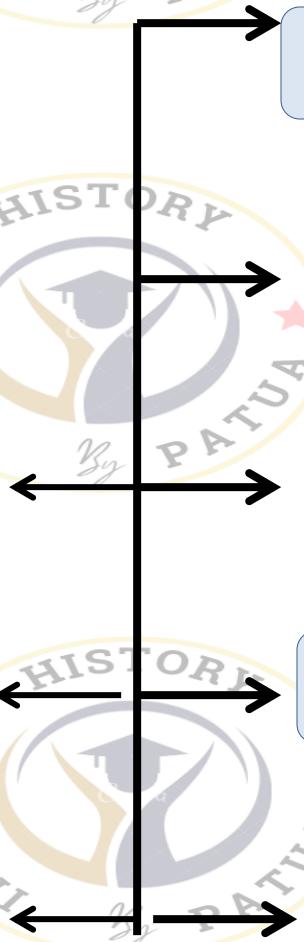
- ✓ While it might lead to favorable growth of species that can utilise this nutrient, nitrogen as a pollutant is often detrimental to the environment and health.

VISUAL POLLUTION

Visual Pollution

✓ **Visual pollution is an aesthetic issue, referring to the impacts of pollution that impair one's ability to enjoy a view. Overcrowding and excessive advertising are both causes of visual pollution.**

The primary sources of pollution are:



- ✓ 1. Haze due to dust and air pollution
- ✓ 2. Garbage heaps and landfills
- ✓ 3. Telecommunication and electric wires and poles
- ✓ 4. Signboards
- ✓ 5. Barren lands and deforestation
- ✓ 6. Urban Jungle- House constructed with bad design
- ✓ 7. Smoke spewing chimneys of factories
- ✓ 8. Graffiti

Thank you …