



CLIMATE CHANGE AND POLLUTION IN INDIA

HOW CLIMATE CHANGE IS AFFECTING THE EARTH



IPL Foundation

What is Climate Change/
Causes and Impact of
Climate Change

Effect of climate changes on
environment and Human
Health

Climate change Mitigation
Strategies/ Why is COP
important

Indian Potash Limited (IPL), incorporated under the Indian Companies Act, was established with the objective of import, handling, promotion, and marketing of potash across the country. Over the years, IPL has evolved into a key player across multiple agricultural value chains, consistently contributing towards agrarian growth and the prosperity of farmers in India.

Extending its commitment beyond business, IPL Foundation, the CSR arm of IPL, is dedicated to driving sustainable development through focused interventions in the areas of sustainability, education, skill development, and community empowerment. Through its Rural Outreach Programme, the Foundation has positively impacted over 2,60,000 farmers by promoting sustainable agricultural practices and enhancing farmer welfare. Its Internship Programme has further engaged more than 2,700 interns across 9 states, offering them valuable exposure to real-world agricultural challenges and practical learning opportunities.

Education and social empowerment remain central to the Foundation's vision. By supporting institutions such as Udhav Shiksha Niketan at Sakoti Tanda and Jarwal Road, IPL Foundation continues to strengthen rural education. Additionally, initiatives like Project PANKH have benefited over 30,000 women and girls by promoting awareness on menstrual health and hygiene.

At the core of IPL Foundation's efforts lies the belief that awareness and knowledge are fundamental to achieving sustainable change. Through Sustainability Conclaves, seminars, capacity-building programmes, and skill development initiatives, the Foundation actively engages students, professionals, and communities in meaningful dialogue on environmental responsibility, climate resilience, and inclusive growth.

In line with this vision, the present booklet has been thoughtfully curated to provide a comprehensive understanding of "***Climate Change and Pollution in the Indian Context***". It highlights their causes, impacts, and the urgent need for integrated and sustainable solutions. The content of this booklet has been carefully compiled from a range of credible sources and research references and organized into a concise and accessible format, enabling readers to access relevant information at one place with ease.

This publication aims to sensitize young minds to the interconnectedness of environmental challenges and sustainable development goals, while encouraging informed action and responsible decision-making. By bridging the gap between academic knowledge and real-world issues, IPL Foundation seeks to empower learners to become aware, responsible citizens and future leaders.

I am confident that this booklet will serve as a valuable resource and inspire constructive engagement towards building a more sustainable and resilient future.

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Climate Change and Pollution in India

Climate Change - Impact and Global Initiatives

1. What is Climate Change?

Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperature.



The main greenhouse gases that are causing climate change include carbon dioxide and methane. These come from using gasoline for driving a car or coal for heating a building, for example. Clearing land and cutting down forests can also release carbon dioxide. Agriculture, oil and gas operations are major sources of methane emissions. Energy, industry, transport, buildings, agriculture and land use are among the main sectors causing greenhouse gases.

2. Causes of Climate Change

- ❖ **Generating power:** A large chunk of global emissions comes from burning fossil fuels to produce electricity and heat. Most electricity is still generated by burning coal, oil, or gas, which produces carbon dioxide and nitrous oxide powerful greenhouse gases that blanket the Earth and trap the sun's heat. Globally, a third of electricity comes from wind, solar and other renewable sources which, as opposed to fossil fuels, emit little to no greenhouse gases or pollutants into the air.
- ❖ **Manufacturing goods:** Manufacturing and industry produce emissions, mostly from burning fossil fuels to generate the energy needed to make things like cement, iron, steel, electronics, plastics, clothes, and other goods. Mining and other industrial processes also release gases, as does the construction industry. Machines used in the manufacturing process often run on coal, oil, or gas. Some materials, like plastics, are made from chemicals sourced from fossil fuels. The manufacturing industry is one of the largest contributors to greenhouse gas emissions worldwide.
- ❖ **Cutting down forests:** Cutting down forests to create farms or pastures, or for other reasons, generates emissions, since trees, when they are cut, release the carbon they had been storing. Each year approximately 10 million hectares of forest are destroyed. Since forests absorb carbon dioxide, destroying them also limits nature's ability to keep emissions out of the

atmosphere. Deforestation, together with agriculture and other land use changes, is responsible for roughly a third of global greenhouse gas emissions.

- ❖ **Using transportation:** Most cars, trucks, ships, and planes run on fossil fuels. This makes transportation a major contributor of greenhouse gases, especially carbon-dioxide emissions. Road vehicles produce the largest part, due to the combustion of petroleum-based products, like gasoline, in internal combustion engines. But emissions from ships and planes continue to grow. Transport accounts for nearly one quarter of global energy-related carbon-dioxide emissions. And trends point to a significant increase in energy use for transport over the coming years.
- ❖ **Producing food:** Producing food causes emissions of carbon dioxide, methane, and other greenhouse gases. This is due, for instance, to deforestation and clearing of land for agriculture and grazing, digestion by cows and sheep, the production and use of fertilizers and manure for growing crops, and the use of fossil fuels to run farm equipment or fishing boats. All this makes food production a major contributor to climate change. Greenhouse gas emissions also come from packaging and distributing food.
- ❖ **Powering buildings:** Globally, residential and commercial buildings consume nearly 60 per cent of all electricity. As they continue to draw on coal, oil, and natural gas for heating and cooling, they emit significant quantities of greenhouse gas emissions. Growing energy demand for heating and cooling, with rising air-conditioner ownership, as well as increased electricity consumption for lighting, appliances, and connected devices, has contributed to a rise in carbon-dioxide emissions from buildings in recent years.
- ❖ **Consuming too much:** Our lifestyles can have a profound impact on our planet. Our use of power at home, how we move around, what we eat and how much we throw away all contribute to greenhouse gas emissions. So does the consumption of goods such as clothing, electronics, and plastics. The wealthiest bear the greatest responsibility: the 20 largest economies are responsible for almost 80 per cent of global emissions. (Source- United Nation climate change).

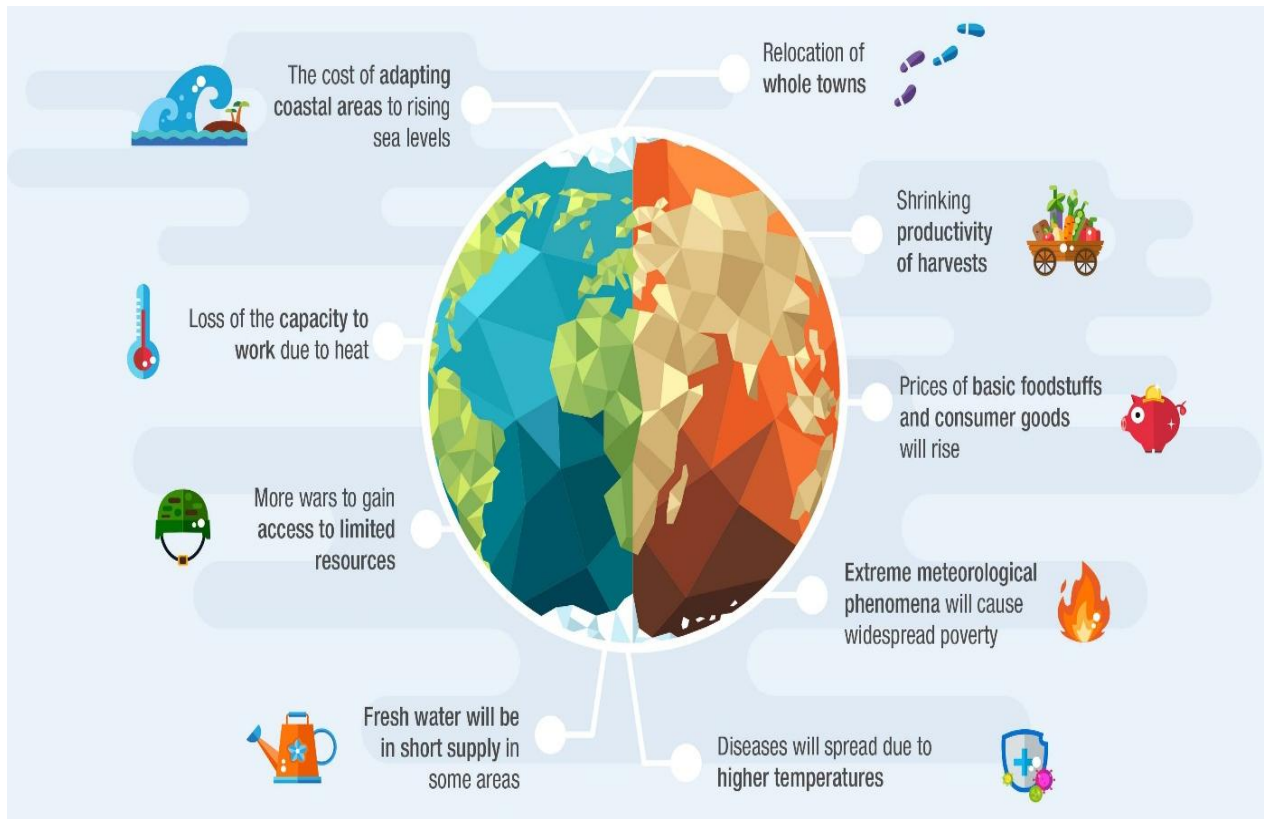
Impact of Climate Change

- ❖ **Hotter temperatures:** As greenhouse gas concentrations rise, so does the global surface temperature. The last decade, 2015-2024, is the warmest on record. Since the 1980s, each decade has been warmer than the previous one. Nearly all land areas are seeing more hot days and heat waves. Higher temperatures increase heat-related illnesses and make working outdoors more difficult. Wildfires start more easily and spread more rapidly when conditions are hotter. Temperatures in the Arctic have warmed at least twice as fast as the global average.

- ❖ **More severe storms:** Destructive storms have become more intense and more frequent in many regions. As temperatures rise, more moisture evaporates. This exacerbates extreme rainfall and flooding, causing more destructive storms. The frequency and extent of tropical storms is also affected by ocean warming. Cyclones, hurricanes, and typhoons feed on warm waters at the ocean surface. Such storms often destroy homes and communities, causing deaths and huge economic losses.
- ❖ **Increased drought:** Climate change is changing water availability, making it scarcer in more regions. Global warming exacerbates shortages in water-stressed regions. It also leads to a higher risk of agricultural droughts affecting crops and ecological droughts making ecosystems more vulnerable. Droughts can also stir destructive sand and dust storms that can move billions of tons of sand across continents. Deserts are expanding, reducing land for growing food. Many people now face the threat of not having enough water on a regular basis.
- ❖ **Loss of species:** Climate change poses risks to the survival of species on land and in the ocean. These risks increase as temperatures climb. Exacerbated by climate change, the world is losing species at a rate 1,000 times greater than at any other time in recorded human history. One million species are at risk of becoming extinct within the next few decades. Forest fires, extreme weather, and invasive pests and diseases are among many threats related to climate change. Some species will be able to relocate and survive, but others will not.
- ❖ **More health risks:** Climate change is a major threat to people's health. Climate impacts are already harming health, through air pollution, disease, extreme weather events, forced displacement, pressures on mental health, and increased hunger and poor nutrition in places where people cannot grow or find sufficient food. Every year, environmental factors take the lives of around 13 million people. Changing weather patterns are expanding diseases, and extreme weather events increase deaths and make it difficult for health care systems to keep up.
- ❖ **Poverty and displacement:** Climate change increase the factors that put and keep people in poverty. Floods may sweep away urban slums, destroying homes and livelihoods. Heat can make it difficult to work in outdoor jobs. Water scarcity may affect crops. In 2024, 45.8 million people were displaced due to weather-related disasters. Most displacements happen in countries that are most vulnerable and least ready to adapt to the impacts of climate change.
- ❖ **Not enough food:** Changes in the climate and increases in extreme weather events are among the reasons behind a global rise in hunger and poor nutrition. Fisheries, crops, and livestock may be destroyed or become less productive. With the ocean becoming more acidic, marine resources that feed billions of people are at risk. Changes in snow and ice cover in many Arctic regions have disrupted food supplies from herding, hunting, and

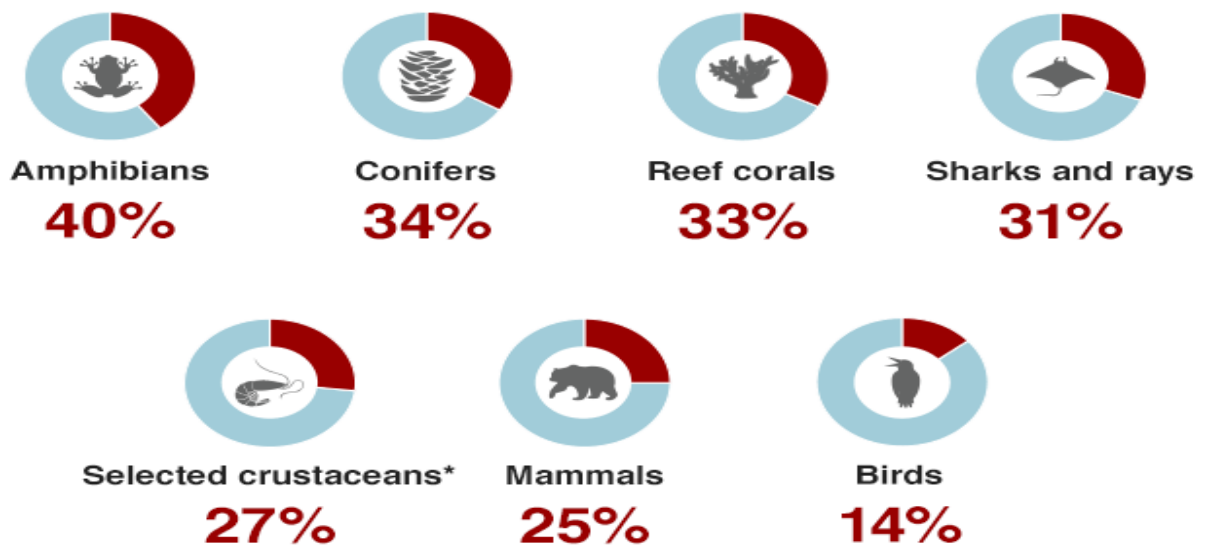
fishing. Heat stress can diminish water and grasslands for grazing, causing declining crop yields and affecting livestock. (Source- United Nation climate change).

3. Effect of climate changes



One in four species are at risk of extinction

Species assessed by the IUCN Red List



*Assessed species include lobsters, freshwater crabs, freshwater crayfishes and freshwater shrimps

Source: IUCN Red List of Threatened Species

BBC

4. Effect of climate change on Human Health

Impact of climate change on health

Respiratory System

- Wildfires and dust storms increase particulate matter and other pollutants causing inflammation of the lungs and exacerbating allergic and respiratory conditions.
- Air pollution may increase susceptibility to respiratory viruses.

Pathogens and Disease Transmission

- Increased incidence of certain vector-borne diseases due to factors like increased seasonal transmission and vectors expanding northward (ex. Dengue, Lyme Disease).
- Increased incidence of certain waterborne diseases can occur due to factors like flooding and water contamination (ex. Cholera, Cryptosporidium).

Mental Health

- High ambient temperatures and heatwaves have been associated with increased suicide, self-harm, aggressive behaviors, as well as psychological morbidity and mortality among people with pre-existing mental disorders.
- Acute events such as hurricanes, wildfires and floods can lead to well-understood psychopathologies, including post-traumatic stress disorder and mood disorders.

Cardiovascular System

- Air pollutants from wildfires increase risk of cardiovascular events such as ischemic stroke, high blood pressure, heart attacks, and cardiac arrhythmias.
- Children exposed to high levels of particulate matter are at increased risk of adverse cardiopulmonary effects early in life.

Immunity and Allergy

- Increasing CO₂ concentration can increase pollen and mold spore production and dispersion increasing allergic disease.
- Pollen is broken up during thunderstorms increasing their allergenic potency and causing sudden increases in acute asthma attacks.



3. Climate change Mitigation Strategies

Climate change mitigation refers to all actions and strategies aimed at **reducing greenhouse gas emissions** or **enhancing natural carbon sinks** so that the rise in global temperature can be limited. Mitigation addresses the **root causes of climate change** and is essential for achieving the goals of the Paris Agreement.

- **Reduction of Greenhouse Gas Emissions:** Reducing greenhouse gas emissions such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) is the core objective of climate change mitigation. These gases trap heat in the atmosphere and are responsible for global warming. Countries reduce emissions by shifting energy systems, improving efficiency, and adopting low-carbon technologies. Under the Paris Agreement, nations submit **Nationally Determined Contributions (NDCs)** that outline their emission-reduction targets and strategies. (Source- UNFCCC- Paris agreement and NDCs)
- **Renewable Energy Transition:** The transition to renewable energy sources such as solar, wind, hydro, and biomass is a key mitigation strategy. Renewable energy generates power with little or no greenhouse gas emissions during operation and reduces dependence on fossil fuels. India has committed to achieving **50% of its installed electricity capacity from non-fossil fuel sources by 2030**, making renewable energy central to its mitigation pathway. (Source- Ministry of new and Renewable energy, Govt. of India)
- **Forest Conservation and Carbon Sinks:** Forests act as natural **carbon sinks** by absorbing carbon dioxide from the atmosphere and storing it in vegetation and soil. Protecting forests, preventing deforestation, and promoting afforestation and reforestation help reduce the concentration of greenhouse gases. India has committed to creating an **additional carbon sink of 2.5–3 billion tonnes of CO₂ equivalent by 2030** through increased forest and tree cover. (Source- Ministry of Environment Forest and climate change, Govt. of India)
- **Energy Efficiency and Energy Conservation:** Energy efficiency involves using **less energy to deliver the same services**, thereby reducing greenhouse gas emissions and energy demand. Measures such as efficient appliances, green buildings, and improved industrial processes play a major role in mitigation. India promotes energy efficiency through national programs and regulatory mechanisms to reduce emissions intensity while supporting economic growth. (Source- Bureau of energy efficiency, Govt. of India)
- **Sustainable Transport Systems:** Mitigation in the transport sector focuses on reducing fossil fuel use and shifting towards low-carbon mobility options such as public transport, railways, electric vehicles, and non-motorized transport. Sustainable transport systems help lower greenhouse gas emissions while improving energy security and accessibility. India's transport mitigation strategies align with national mobility and electrification missions. (Source- NITI Aayog).

- **Integrated Approach to Climate Mitigation:** Effective mitigation requires a **multi-sectoral and integrated approach**, combining policy measures, technological innovation, finance, and behavioural change. Governments, industries, communities, and individuals all play a role in reducing emissions. Long-term mitigation strategies must align with sustainable development goals to ensure climate action supports economic and social development. (Source- United Nations- Sustainable Developments goals)

Adaptation Strategies to Combat Climate Change

Climate change is making farming harder by increasing natural disasters, reducing water availability, and causing land and biodiversity loss. This puts many communities at risk.

Key Adaptation Strategies:

- **Technology & Awareness:** New farming techniques and educating farmers and policymakers are essential for adapting to climate change.
- **Community-Driven Programs:** Involving village institutions and collective efforts are more effective than individual actions.
- **Government Collaboration:** Coordination between different government programs at the village level can maximize the benefits of climate adaptation initiatives.
- **Improved Farming Practices:** Modern techniques help reduce climate risks and also cut greenhouse gas emissions.
- **Water Management:** Since half of Indian farming relies on rain, conserving rainwater through farm ponds and community storage is a top priority. In times of water scarcity, livestock should be prioritized, followed by horticulture and crops.
- **Integrated Farming Systems (IFS):** Promote models that combine crops, livestock, fisheries, and horticulture to optimize resource use and reduce risk from mono-cropping.
- **Climate-Resilient Crop Varieties:** Promote drought-tolerant, flood-resistant, and heat-resilient crop varieties.

Priority of water utilization in agriculture sub-sectors under limited water availability

- ▶ Livestock Drinking Water
- ▶ Horticulture/ High Value Plantations
- ▶ Annual Field Crops



4. Conference of the Parties (COP) – Global Initiatives & Actions

The Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC) is an international climate summit, which is held annually unless the Parties (the

countries involved) decide otherwise. The UNFCCC was established in 1992 at the Earth Summit in Brazil. At COPs, world leaders gather to work together on solutions to tackle climate change, to negotiate and agree action on how to tackle climate change, limit emissions and halt global warming. The UNFCCC conferences are the world's highest decision-making body on climate issues.

Why is COP important?

Climate change is already causing severe devastation globally and as temperatures continue to rise, the risks are increasing too. In the 2015 Paris Agreement governments committed to limit the rise in the global average temperature to 'well below' 2°C above pre-industrial levels, ideally 1.5°C. Progress towards these goals is, however, way off track. Every five years, the signatory governments to the Paris Agreement are requested to submit new national climate plans (Nationally Determined Contributions, NDCs). These generally include a numerical target for how much a country should have reduced its emissions by a certain year (e.g 2030 or 2035).

A. COP26: Together for our planet: The 2021 United Nations Climate Change Conference, more commonly referred to as COP26, was the 26th United Nations Climate Change Conference, held at the SEC Centre in Glasgow, Scotland, United Kingdom, from 31 October to 13 November 2021.

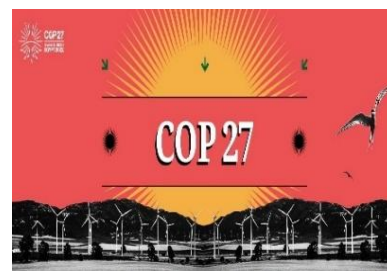
The outcome of COP26 the Glasgow Climate Pact is the fruit of intense negotiations among almost 200 countries over the two weeks.



At the COP 26 summit in Glasgow in November 2021, **Hon'ble Prime Minister Narendra Modi** pledged commitments by India to achieve its short term and long-term targets under the **PANCHAMRIT ACTION PLAN**

- **Emissions Intensity:** India has reduced emissions intensity by ~**33%** from 2005 levels and is on track to meet the **45% reduction target by 2030**.
- **Carbon Emission Reduction:** India aims to cut **1 billion tonnes** of cumulative carbon emissions by 2030, supported by cleaner transport, energy efficiency, and green industry.
- **Non-Fossil Power Capacity:** India has reached **47.4%** of installed capacity from non-fossil sources, nearing the **50% target** well ahead of 2030.
- **500 GW Renewable Energy:** As of May 2025, **232 GW** of renewable energy is installed, with over **245 GW more in the pipeline**—moving steadily toward the 2030 goal.
- **Net Zero by 2070:** India is advancing its long-term goal through green hydrogen, EVs, and sustainable infrastructure, though international support remains key.

B. COP 27: Together for Implementation: COP27 took place from November 6–20, 2022 in Sharm el-Sheikh, Egypt. The conference's theme was "Together for Implementation". COP27 concludes with a historic decision to establish and operationalize a loss and damage fund. "Together, let not relent in the fight for climate justice and climate ambition," said the Secretary-General in his closing messaging.



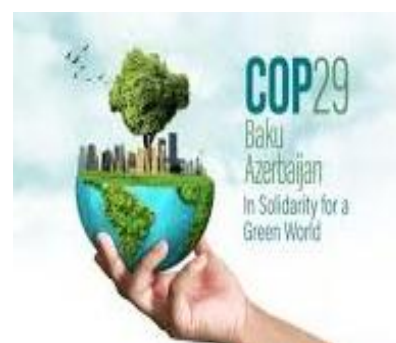
C. COP 28: Climate Finance, Urgency, and Social Justice: COP28 took place from 30 November to 12 December 2023 at Expo City, Dubai in the United Arab Emirates. COP28 UAE provided a milestone opportunity for the world to come together, course correct, and drive progress to keep 1.5C within reach - so we can meet the goals and ambitions of the Paris Agreement. COP28 UAE was a transformational moment for the world to unite around tangible climate action and deliver realistic solutions.



Achieving this requires collaboration across civil society, governments, industries and sectors.

D. COP 29: Advancing Global Climate Action - Finance, Carbon Markets, and Sustainability:

➤ **Climate Finance:** A new global finance goal was agreed to mobilize USD 1.3 trillion annually by 2035 for climate support to developing countries. Within this, USD 300 billion per year is to be dedicated exclusively to climate action, including mitigation and adaptation. The actual pledges still fall short, with wealthy nations criticized for not meeting earlier USD 100 billion/year.



➤ **Carbon Markets – Article 6 (Paris Agreement):** COP29 finalized the long-awaited rules for Article 6.2 and 6.4, which enable voluntary carbon credit trading between countries and establish a global carbon crediting mechanism. This decision will help countries cooperate to reduce emissions more cost-effectively and bring transparency to global carbon markets.

➤ **Gender & Global Goal on Adaptation (GGA):** The Lima Work Programme on Gender was extended for another 10 years, reinforcing the role of women in climate solutions. Countries adopted a framework of indicators for measuring progress under the Global Goal on Adaptation (GGA), giving direction for adaptation tracking and finance.

➤ **Loss and Damage Fund:** The Loss and Damage Fund, first agreed at COP27 and launched at COP28, was operationalized with governance rules at COP29. Initial funding reached about USD 700 million, but still far below the estimated USD 100–150 billion/year needed by vulnerable countries to cope with climate-related disasters.

- **Global Stocktake (GST) – Setback:** Despite intense negotiations, no agreement was reached on how to implement the first Global Stocktake, which had been finalized at COP28. The issue was deferred to COP30 in Brazil (2025), disappointing many developing nations seeking clearer pathways to reduce emissions in line with the 1.5°C goal.

E. COP 30: Advancing about Sustainability and Climate Change: COP-30, held in **Belém, Brazil (Amazon region)**, marked a turning point in global climate action, shifting the focus from planning to real-world implementation of climate commitments. With the Amazon at its core, COP-30 highlighted the critical role of **forests, biodiversity, and indigenous communities** in combating climate change.

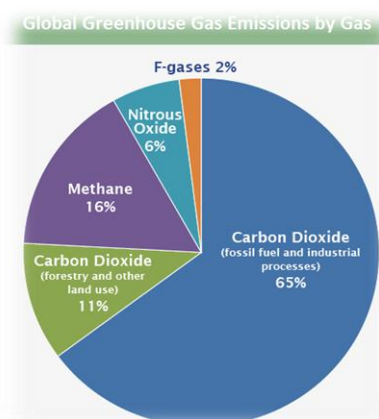


The conference reinforced the urgency of limiting global warming to **1.5°C** under the **Paris Agreement**, emphasizing climate finance, emission reduction, adaptation, and loss & damage support for vulnerable countries. A central theme of COP-30 was the protection of forests and biodiversity, recognizing the Amazon as a global climate stabilizer and carbon sink. The conference highlighted the role of nature-based solutions, sustainable land use, and indigenous knowledge in reducing emissions and enhancing climate resilience.

COP-30 also strengthened the focus on **climate finance**, urging developed nations to mobilize predictable and adequate funding for **mitigation, adaptation, and loss-and-damage** support to developing and climate-vulnerable countries. Equal emphasis was placed on **climate justice**, ensuring that climate action supports livelihoods, social inclusion, and sustainable development.

5. Greenhouse effect and Global warming

A. Greenhouse effect: The greenhouse effect is the process thanks to which Earth has a higher temperature than it would have without it. The gases that radiate heat also known as greenhouse gases absorb the energy radiated out by the Earth and reflect a part of it back to Earth. Of all the energy that the Earth receives from the Sun, a part of it around 26% is reflected back to space by the atmosphere and clouds. Some part of it is absorbed by the atmosphere, around 19%. The rest hits the ground and heats the surface of the Earth. This absorbed energy is radiated out of the earth in the form of Infrared Waves.



These IR waves warm the atmosphere above the Earth. The atmosphere again radiates this energy it received from the Earth both upwards and downwards. This greenhouse effect is essential to supporting life on Earth.

B. Major Greenhouse Gases: Carbon dioxide (CO₂) is the most significant greenhouse gas, primarily released from burning fossil fuels, cement production, and deforestation. Methane (CH₄), emitted from agriculture, livestock, landfills, and oil and gas operations, is 28–36 times more potent than CO₂ over a 100-year period. Nitrous oxide (N₂O) is released from fertilizer use, industrial activities, and waste treatment. Fluorinated gases are synthetic gases used in refrigeration and industrial processes and have extremely high global warming potential. Agriculture contributes nearly one-third of total greenhouse gas emissions globally.

- **Is Ozone a greenhouse gas?**

The ozone is a layer present in the lower part of the Earth's stratosphere. This ozone layer has a role in absorbing radiation (UV-rays) coming from the sun. If this ozone is found in the troposphere layer, it can become a greenhouse gas leading to the greenhouse effect. Also, the thinning or depletion of the stratospheric ozone layer can lead to several health defects. Most substances that deplete stratospheric ozone are also greenhouse gases. The ozone layer must be protected from the following ozone-depleting substances (ODS).

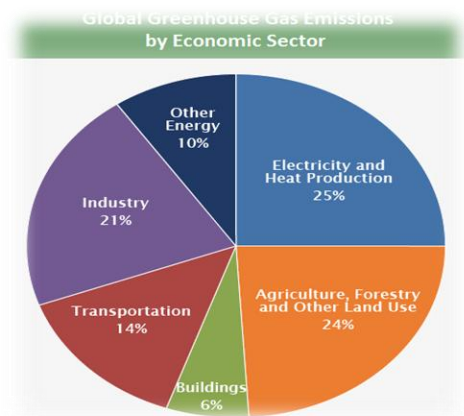
List of Ozone's depleting Substance

- ❖ Hydrofluorocarbons
- ❖ Chlorofluorocarbons
- ❖ Methyl Chloroform
- ❖ Hydrobromofluorocarbons
- ❖ Methyl bromide
- ❖ Carbon tetrachloride
- ❖ Chlorobromomethane

C. Humans are responsible for global warming: Climate scientists have showed that humans are responsible for virtually all global heating over the last 200 years. Human activities like the ones mentioned above are causing greenhouse gases that are warming the world faster than at any time in at least the last two thousand years. The average temperature of the Earth's surface is now about 1.1°C warmer than it was in the late 1800s (before the industrial revolution) and warmer than at any time in the last 100,000 years. The last decade (2011-2020) was the warmest on record, and each of the last four decades has been warmer than any previous decade since 1850.



D. Global and Regional Climate Trends: Climate data shows that the last decade was the warmest on record globally. Asia is warming nearly twice as fast as the global average. India recorded its hottest year since 1901 in 2024, with more frequent and intense heatwaves. Climate models project that global mean surface temperature could rise between 1°C and 4.5°C by 2100 if emissions are not controlled.



E. Causes of Greenhouse Effect: The following are the factors that are responsible for the cause of greenhouse effect.

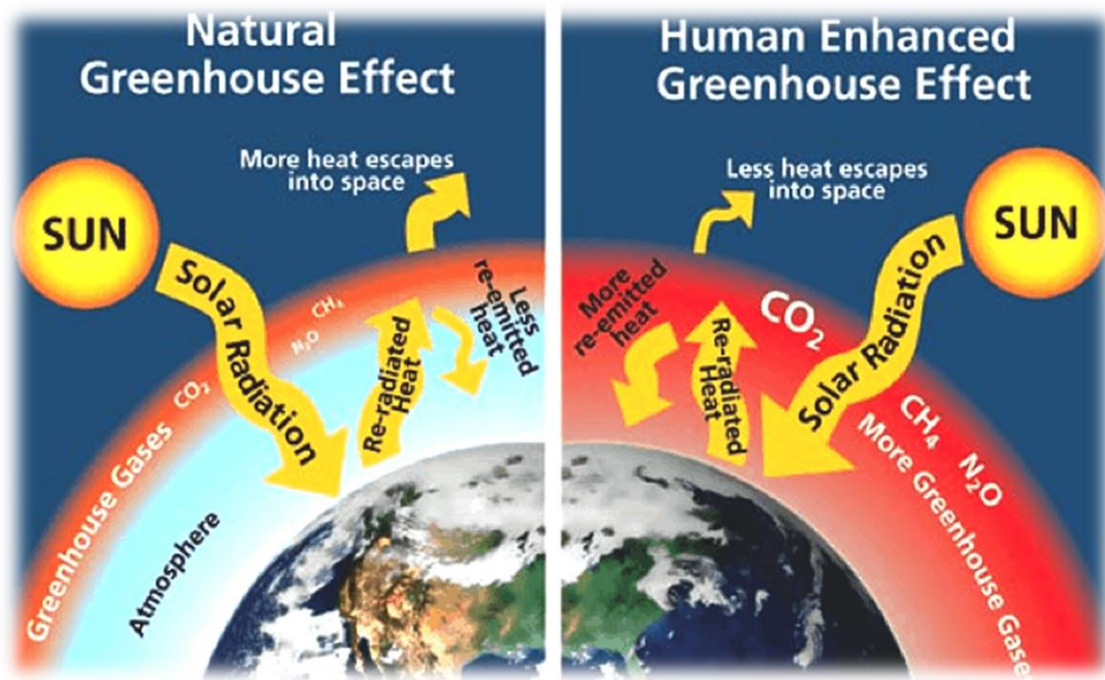
- ❖ **Deforestation:** This is considered to be one of the most responsible factors for the cause of the greenhouse effect. This is due to the reduction in the release of oxygen and absorption of carbon dioxide by the plants.
- ❖ **Fossil fuel burning:** Fossil fuels such as coal, oil, and natural gases are used as a means of energy which releases a huge amount of harmful gases into the environment.
- ❖ **Population:** As the population increases, the need for space increases which again results in deforestation.

F. Greenhouse Effect and Global Warming: Usually, the radiation that reaches the Earth's surface is emitted back into space. The presence of greenhouse gases in the atmosphere leads to the trapping of these radiations and in turn leads to the greenhouse effect. Thus, an increase in greenhouse gases will eventually warm up the Earth surface leading to a phenomenon called global warming. Also, the natural greenhouse effect is vital in maintaining the Earth's temperature to sustain life. Without these gases, all of Earth's trapped heat will pass out into the space and leads to a freezing planet. Scientific evidence from the **IPCC AR6** confirms that global temperatures have risen by approximately **1.1°C** since pre-industrial times, largely due to human-induced greenhouse gas emissions. The **India Meteorological Department (IMD)** reported **2024 as the hottest year in India since 1901**, with rising trends in both day and night temperatures.

This warming has led to significant environmental impacts:

- Rising sea levels
- Melting glaciers and Arctic Ice
- Shifting rainfall patterns

- More frequent and severe heatwaves, floods, droughts, and cyclones.



6. Renewable energy and Climate change Mitigation:



The Sun has been revered as a life-giver since ancient times. With industrial advancement, we began to understand sunlight as a powerful energy source. India is richly endowed with solar potential receiving nearly **5,000 trillion kWh of solar energy annually**, with most regions getting 4–7 kWh per sq. m. per day. Solar photovoltaic power offers vast scalability, the flexibility for distributed generation, and quick capacity addition with short lead times. Off-grid and low-temperature solar applications are particularly valuable for rural areas, meeting needs for power, heating, and cooling in both rural and urban settings. From an energy security perspective, solar is the most reliable source due to its abundance; theoretically, even a small fraction of harnessed solar energy could meet India's entire power demand.

In recent years, solar energy has made a notable impact on India's energy landscape. Decentralized and distributed solar applications have benefited millions in villages providing clean cooking, lighting, and energy solutions. This has reduced the drudgery of collecting firewood, improved health by minimizing smoke-related ailments, generated employment, and raised living standards. Additionally, solar has become a key contributor to India's grid-connected power capacity, aligning with the nation's sustainable growth agenda and strengthening energy security.

The **National Institute of Solar Energy (NISE)** estimates India's solar potential at **about 748 GW**, assuming just 3% of wasteland is used for solar PV installations. Solar energy is central to India's **National Action Plan on Climate Change**, with the **National Solar Mission (NSM)** launched on **11 January 2010** aiming to position India as a global solar leader by enabling rapid technology adoption. This supports India's **Nationally Determined Contributions (NDCs)** to achieve 50% of installed electric capacity from non-fossil fuel sources and reduce GDP emission intensity by 45% from 2005 levels by 2030.

Other promotional measures include:

- ✓ 100% FDI under the automatic route.
- ✓ Waiver of Inter-State Transmission System (ISTS) charges for eligible projects.
- ✓ Declared Renewable Purchase Obligation (RPO) trajectory till 2029–30.
- ✓ Standards for solar PV systems/devices.
- ✓ A Project Development Cell to attract investments.
- ✓ Standard bidding guidelines for tariff-based procurement.
- ✓ Payment security through Letters of Credit (LC) or advance payment.
- ✓ Green Energy Open Access Rules 2022.
- ✓ Late Payment Surcharge (LPS) rules.
- ✓ Green Term Ahead Market (GTAM) for renewable energy trading.

India ranks **5th globally** in solar PV deployment (REN21 Global Status Report 2023 & IRENA Renewable Capacity Statistics 2023) with an installed solar capacity of **around 70.10 GW**.

7. Government Schemes

A. PM-KUSUM Scheme: Empowering Farmers with Solar Energy: The **Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyaan (PM-KUSUM)** is a flagship initiative by the Government of India to promote the use of solar energy in agriculture. The goal is to install **34,800 MW of solar capacity** across the country by **March 2026**, with **₹34,422 crore** in central government support. This scheme not only ensures reliable irrigation for farmers but also helps them earn extra income by selling surplus power to the grid.

Three Key Components of PM-KUSUM

- 1. Decentralized Solar Power Plants (Component-A)**
 - Installation of **10,000 MW** of small solar or renewable energy plants (500 kW to 2 MW each).

- Can be set up by farmers, farmer groups, cooperatives, panchayats, FPOs, or WUAs.
- If farmers lack funds, they can partner with developers or the local electricity company (DISCOM).
- DISCOMs will buy the power at state-approved rates and receive an incentive of ₹0.40 per unit or ₹6.6 lakh per MW (whichever is lower) for 5 years.

2. Stand-alone Solar Pumps (Component-B)

- **14 lakh** solar-powered pumps (up to 7.5 HP) will be installed in areas without electricity.
- **Cost sharing:**
 - **Central Government:** 30% subsidy
 - **State Government:** At least 30% subsidy
 - **Farmer:** Up to 40% (loan option available; only 10% upfront payment required)
- Special category states/UTs (North East, Sikkim, J&K, Himachal, Uttarakhand, Lakshadweep, A&N Islands) receive 50% central subsidy, 30% state subsidy, and pay only 20% themselves.
- Farmers can still get central subsidy even if their state cannot provide its share.

3. Solarisation of Existing Grid-connected Pumps (Component-C)

This has two options:

(i) Individual Pump Solarisation (IPS):

- Farmers with electric pumps can install solar panels (up to double the pump's capacity).
- Use solar power for irrigation and sell extra electricity to DISCOMs.
- Subsidy: 30% from the Centre, at least 30% from the State, and up to 40% from the farmer (loan available; only 10% upfront payment).

(ii) Feeder Level Solarisation (FLS):

- States can solarise entire agricultural power feeders instead of individual pumps.
- Provides daytime reliable power to farmers, free or at state-decided rates.
- Subsidy:
 - General states: 30% (up to ₹1.05 crore/MW)
 - Special category states/UTs: 50% (up to ₹1.75 crore/MW)

Can be set up under **CAPEX** or **RESCO** models with a 25-year agreement.

How Farmers Can get the benefits

For Component-A:

- DISCOMs will announce available capacity and invite applications.
- Farmers can install plants themselves or lease land to developers/DISCOMs.
- Power purchase agreements ensure steady income.

For Component-B & C (IPS):

- MNRE allocates targets to states; farmers apply through state agencies.
- Projects to be completed within **24 months** of approval.

- Farmers pay only their share; subsidies are adjusted in the cost.

For Component-C (FLS):

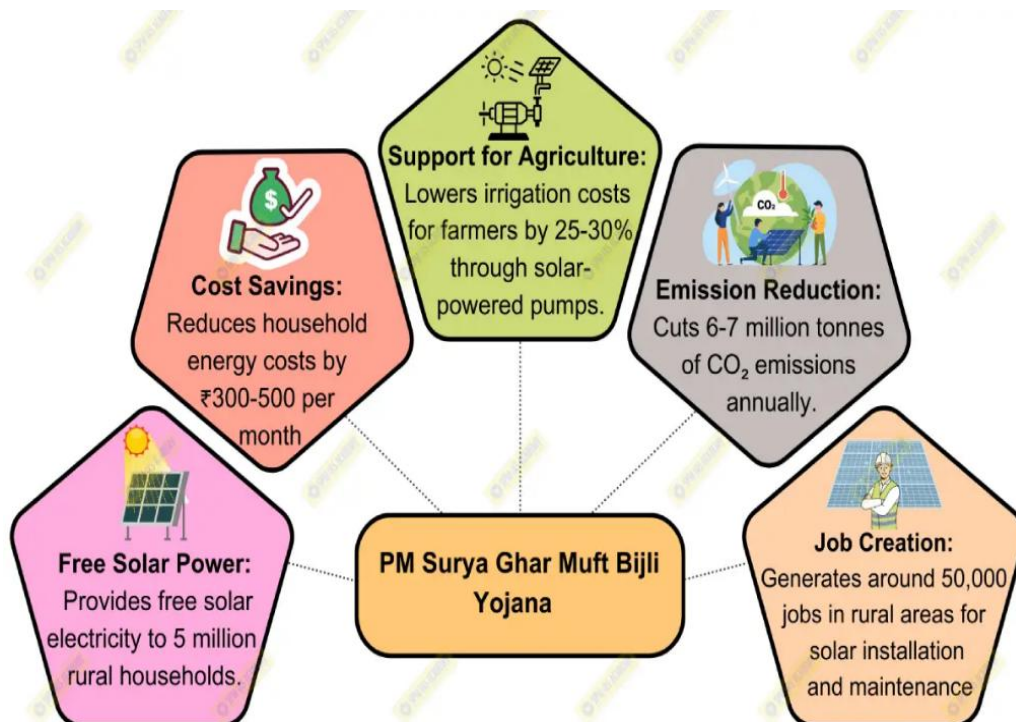
- Subsidy released to DISCOMs in phases 30% after initial work, balance after milestones are met.

B. PM Surya Ghar: Muft Bijli Yojana: PM Surya Ghar and Muft Bijli Yojana is a flagship rooftop solar programme launched by the Government of India in February 2024 to provide **up to 300 units of free electricity per month to 1 crore households**. With a total budget of ₹75,021 crore, the scheme aims to accelerate the adoption of clean and renewable energy while reducing dependence on conventional electricity sources.

- ✓ **Up to 2 kW capacity** – 60% subsidy (approx. ₹30,000 per kW)
- ✓ **2–3 kW capacity** – 40% subsidy, with a maximum subsidy limit of ₹78,000.

Eligibility: The beneficiary must be an Indian citizen, own a suitable rooftop, hold a valid electricity connection, and not have availed a similar solar subsidy earlier.

Application process: Applicants can register on the official PM Surya Ghar portal by selecting their state and DISCOM, providing their electricity consumer details, and choosing a registered vendor. Post DISCOM approval, installation is carried out, net metering is set up, and the subsidy is directly credited to the beneficiary’s bank account.



Benefits:

- ✓ Significant savings on electricity bills (up to 300 units free per month)
- ✓ Contribution to reducing carbon footprint and combating climate change
- ✓ Income generation through net metering by selling surplus power to the grid

- ✓ Job creation in the renewable energy sector, especially for solar technicians

This initiative is a key step towards achieving India's **National Solar Mission** targets, enhancing energy security, and fostering a sustainable future for the country. With initiatives like PM-KUSUM and PM Surya Ghar, India is not only harnessing the limitless power of the sun but also empowering communities, ensuring energy security, and paving the way for a cleaner, sustainable future.

8. Interlinkage between Climate Change and Pollution in India

Climate change and pollution are closely interconnected environmental challenges. While pollution contributes to climate change through greenhouse gas emissions, climate change in turn **intensifies the severity, spread, and impacts of pollution**. In India, rising temperatures, changing rainfall patterns, and increasing frequency of extreme weather events are worsening air, water, and soil pollution, thereby posing serious risks to human health, ecosystems, and sustainable development.

- ❖ **Climate Change and Air Pollution:** Climate change significantly affects air quality by altering atmospheric conditions. Rising temperatures accelerate chemical reactions in the atmosphere, leading to increased formation of ground-level ozone and smog. Heatwaves and stagnant weather conditions reduce air circulation, causing pollutants to remain trapped near the Earth's surface for longer periods. (Source- WHO, Climate change and air quality)
- ❖ **Climate Change and Water Pollution:** Climate change influences water pollution through extreme rainfall, floods, and rising temperatures. Intense rainfall events wash untreated sewage, agricultural runoff, and industrial waste into rivers, lakes, and groundwater sources. Flooding overwhelms drainage and wastewater treatment systems, leading to contamination of drinking water supplies. Higher water temperatures also reduce dissolved oxygen levels, affecting aquatic life and increasing the concentration of pollutants. (Source- Ministry of Jal shakti, Govt of India)
- ❖ **Climate Change, Extreme Weather Events and Pollution:** Climate change is increasing the frequency and intensity of extreme weather events such as floods, droughts, cyclones, and heatwaves. These events disrupt waste management systems, damage industrial infrastructure, and mobilize accumulated pollutants in the environment. Droughts lead to dry soils and increased dust pollution, while cyclones and storms spread pollutants over large areas. (Source- Indian Metrology department IMD)
- ❖ **Climate Change and Forest Fires:** Rising temperatures and prolonged dry conditions caused by climate change have increased the risk of forest fires. Forest fires release large quantities of particulate matter and greenhouse gases into the atmosphere, severely degrading air quality over vast regions. In India, climate-driven forest fires in

Himalayan and central forest regions have resulted in sudden spikes in air pollution, affecting both rural and urban populations.

- ❖ **Combined Impact on Human Health:** The combined effects of climate change and pollution pose serious threats to human health. Heat stress, poor air quality, contaminated water, and the spread of climate-sensitive diseases increase health risks, particularly for children, the elderly, and economically vulnerable populations. (Source- WHO- climate change and health)
- ❖ **Need for an Integrated Approach:** Addressing climate change and pollution separately is no longer sufficient. Integrated strategies that simultaneously reduce emissions, improve environmental quality, and build climate resilience are essential. Policies promoting clean energy, sustainable transport, ecosystem protection, and climate-resilient infrastructure can deliver co-benefits for both climate mitigation and pollution reduction. An integrated approach supports sustainable development and improves environmental and human well-being. (Source- United Nations Environment Programme UNEP)

09. Pollution in India

Introduction

Pollution is one of the major environmental problems affecting the world today. Pollution and climate change are among the most serious environmental challenges facing India today. Rapid industrialization, urban growth, vehicular emissions, and unsustainable use of natural resources have led to rising air, water, and soil pollution. These factors are contributing to climate change, resulting in increasing temperatures, irregular rainfall, floods, droughts, and extreme weather events. The impacts are affecting agriculture, public health, biodiversity, and livelihoods across the country. Addressing pollution and climate change is essential for sustainable development and environmental protection in India.

Air pollution, primarily caused by vehicle emissions, industrial activities, construction dust, and stubble burning, often results in hazardous air quality levels, especially in urban areas. Delhi remains the most polluted capital. India ranked fifth in air pollution in 2024, improving from third place in 2023. Water pollution is another major concern, with rivers such as the Ganga and Yamuna suffering from untreated sewage, industrial effluents, and agricultural runoff. Additionally, excessive use of chemical fertilizers and pesticides contributes to soil contamination, while the proliferation of single-use plastics poses a long-lasting environmental threat.



The impacts of pollution in India are profound. Public health is severely affected, with respiratory diseases, cardiovascular problems, and waterborne illnesses becoming widespread. Children, in particular, face developmental delays and cognitive impairments due to prolonged exposure to pollutants. Economically, pollution leads to productivity losses, increased healthcare costs, and reduced agricultural output. Environmental consequences include habitat destruction, biodiversity loss, and the exacerbation of climate change through greenhouse gas emissions.



To combat these challenges, India has implemented several sustainability measures. Policies like the National Clean Air Programme (NCAP) aim to reduce particulate pollution, while initiatives like the Swachh Bharat Mission focus on waste management and sanitation. Efforts to ban single-use plastics.

Pollution: Pollution is the introduction of harmful substances or activities into the environment that cause damage to air, water, soil, plants, animals, and human health. It makes the environment dirty, unsafe, and unfit for living.



A. Types of Pollution

As stated before, there are different types of pollution, which are either caused by natural events (like forest fires) or by man-made activities (like cars, factories, nuclear wastes, etc.) These are further classified into the following types of pollution. (Source- Byjus)



1. Air Pollution: Air pollution refers to the release of harmful contaminants (chemicals, toxic gases, particulates, biological molecules, etc.) into the earth's atmosphere. These contaminants are quite detrimental and, in some cases, pose serious health issues. Some causes that contribute to air pollution are Burning fossil fuels, Mining operations and Exhaust gases from industries and factories. Two types of Air Pollutions are given below:

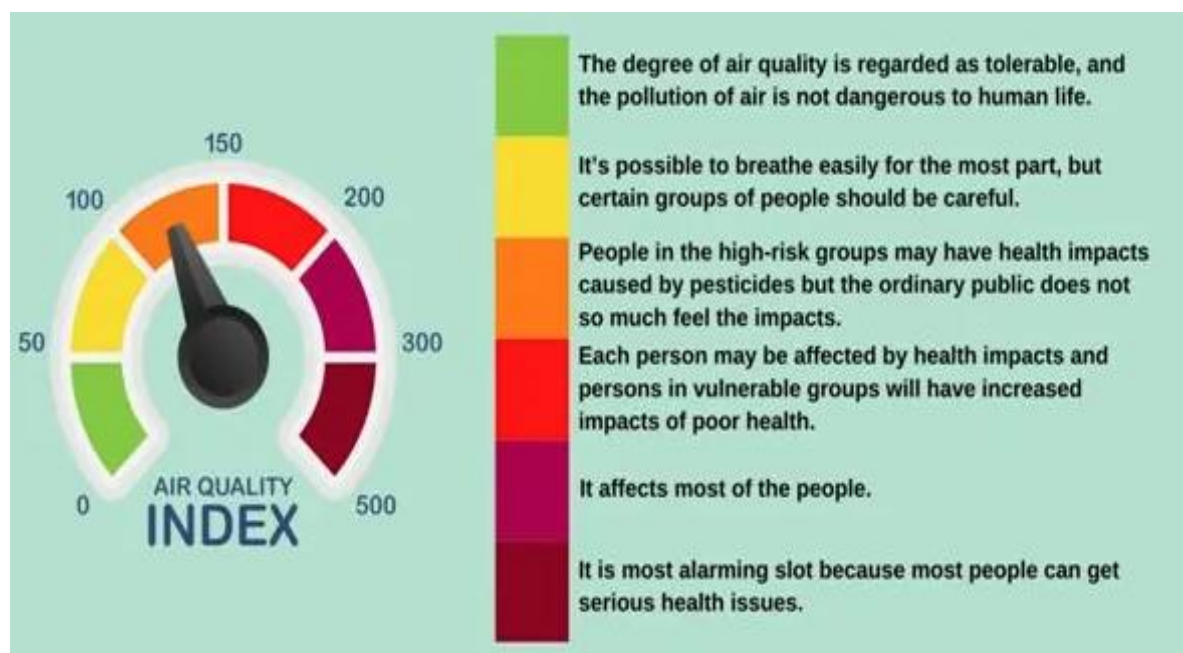


- A. Primary Pollutants:** The pollutants that directly cause air pollution are known as primary pollutants. Sulphur-dioxide emitted from factories is a primary pollutant.
- B. Secondary Pollutants:** The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants. Smog, formed by the intermingling of smoke and fog, is a secondary pollutant.

Causes of Air Pollution

- ❖ **Burning of Fossil Fuels:** The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.
- ❖ **Agricultural Activities:** Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilisers emit harmful chemicals in the atmosphere and contaminate it.
- ❖ **Factories and Industries:** Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.
- ❖ **Domestic Sources:** The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.
- ❖ **Mining Activities:** In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air, but also deteriorate the health of the workers and people living in the nearby areas.

Air Quality Index



Effects of Air Pollution

- ❖ **Disease:** Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.
- ❖ **Global Warming:** Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged underwater.
- ❖ **Acid Rain:** The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life.
- ❖ **Ozone Layer Depletion:** The release of chlorofluorocarbons, halons, and hydrochlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.
- ❖ **Effect on Animals:** The air pollutants suspend in the water bodies and affect aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animal species.

Control of Air Pollution



- ❖ **Avoid using Vehicles:** People should avoid using vehicles for shorter distances. Rather, they should prefer public modes of transport to travel from one place to another. This not only prevents pollution, but also conserves energy.
- ❖ **Energy Conservation:** A large number of fossil fuels are burnt to generate electricity. Therefore, do not forget to switch off the electrical appliances when not in use. Thus, you can save the environment at the individual level.

- ❖ **Use of Clean Energy Resources:** The use of solar, wind and geothermal energies reduce air pollution at a larger level. Various countries, including India, have implemented the use of these resources as a step towards a cleaner environment.

Government Policies

- **National Clean Air Programme (NCAP):** NCAP (launched 2019) was strengthened and has been revised toward an overall ~40% reduction in PM levels by 2026 for NCAP cities, backed by central funding to municipal/state agencies for specific interventions.
- **Graded Response Action Plan (GRAP):** GRAP is a stage-wise emergency framework to control severe air pollution in the Delhi–NCR region. It mandates pre-defined measures linked to AQI levels, enabling timely, automatic restrictions on pollution sources such as construction, transport, and industry, under the supervision of the **Commission for Air Quality Management (CAQM)**.

Graded Response Action Plan (GRAP)

GRAP Stages

State	Category	AQI	AQI Color Code
Stage 1	Poor	201–300	
Stage 2	Very poor	301–400	
Stage 3	Severe	401–450	
Stage 4	Severe plus	451 and above	

- **Monitoring, Data & Forecasting:** India has strengthened air-pollution control through expanded real-time monitoring and forecasting. The Central Pollution Control Board (CPCB) has widened the CAAQMS/NAQI network, providing live AQI data via national dashboards that help authorities trigger GRAP actions in time. Improved air-quality forecasting and modelling, developed through CPCB collaborations with the Indian Metrological Department (IMD) and research institutions, enables early warnings and dynamic GRAP activation.
- **Transport & Vehicular Emissions:** Cities have tightened control over vehicular pollution through strict PUC enforcement and the “no-PUC, no-fuel” rule, especially in Delhi.

- **EV Push, Charging Infrastructure & Municipal Plans:** Urban bodies are accelerating the shift to electric mobility by expanding charging infrastructure and reforming parking policies. **For example**, the Municipal Corporation of Delhi (MCD) plans to scale up EV charging stations from about 422 to nearly 994, aiming to cut congestion and idle emissions.
 - **Agriculture / Crop-Residue (Stubble) Burning Solutions:** To curb stubble burning, governments are scaling up in-situ residue management through subsidies for machines like happy seeders and straw mulchers, backed by financial incentives and procurement support under state action plans. Satellite-based monitoring enables quick detection of fire hotspots, allowing targeted enforcement, penalties, and timely incentives during peak burning months (Oct–Nov). As a result, the stubble burning in Punjab and Haryana has reduced by 50% this season as compared to 2024.
 - **Anti-Smog Guns and Dust Control:** Mandatory anti-smog guns will be installed at all buildings larger than 3,000 square meters, including malls, hotels, and high-rise complexes, to suppress dust through water misting. 1,000 water sprinklers and 140 anti-smog guns will be deployed across the city.
2. **Water Pollution:** **Water pollution** is said to occur when toxic pollutants and particulate matter are introduced into water bodies such as lakes, rivers and seas. These contaminants are generally introduced by human activities like improper **sewage treatment** and oil spills. However, even natural processes such as eutrophication can cause water pollution.



Sources of Water Pollution:

- Urbanization
- Deforestation
- Industrial effluents
- Social and Religious practices
- Use of Detergents and Fertilizer
- Agriculture run-offs use of pesticides and Insecticides

Water Pollution - A Modern Epidemic:



One of the primary causes of water pollution is the contamination of water bodies by toxic chemicals. As seen in the example mentioned above, the dumped plastic bottles, tins, water cans and other wastes pollute the water bodies. These result in water pollution, which harms not just humans, but the whole ecosystem. In most cases, the outcome is destructive to only the local population and species, but it can have an impact on a global scale too. Nearly 6 billion kilograms of garbage is dumped every year in the oceans. Apart from industrial effluents and untreated sewage, other forms of unwanted materials are dumped into various water bodies.

Effects of Water Pollution

The effect of water pollution depends upon the type of pollutants and their concentration. Also, the location of water bodies is an important factor to determine the levels of pollution.

- Water bodies in the vicinity of urban areas are extremely polluted. This is the result of dumping garbage and toxic chemicals by industrial and commercial establishments.
- The effect of water pollution can have a huge impact on the food chain. It disrupts the food chain.
- Humans are affected by pollution and can contract diseases such as hepatitis through faecal matter in water sources. Poor drinking water treatment and unfit water can always cause an outbreak of infectious diseases such as cholera etc.
- The ecosystem can be critically affected, modified and restructured because of water pollution.
- Water pollution drastically affects aquatic life. It affects their metabolism, and behaviour, and causes illness and eventual death. Dioxin is a chemical that causes a lot of problems from reproduction to uncontrolled cell growth or cancer. This chemical is bioaccumulated in fish, chicken and meat.

Pollution of the Ganges

Some rivers, lakes, and groundwater are rendered unfit for usage. In India, the River Ganges is the sixth most polluted river in the world. This is unsurprising as hundreds of industries nearby

release their effluents into the river. Furthermore, religious activities such as burials and cremations near the shore contribute to pollution. Apart from the ecological implications, this river poses a serious health risks as it can cause diseases like typhoid and cholera.

As per a survey, by the end of 2026, around 4 billion people will face a shortage of water. Presently, around 1.2 billion people worldwide do not have access to clean, potable water and proper sanitation. It is also projected that nearly 1000 children die every year in India due to water-related issues. Groundwater is an important source of water, but unfortunately, even that is susceptible to pollution. Hence, water pollution is quite an important social issue that needs to be addressed promptly.

Control Measurement of Water Pollution

Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste into water bodies, it is better to treat them before discharge. Practising this can reduce the initial toxicity and the remaining substances can be degraded and rendered harmless by the water body itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields. A very special plant, the Water Hyacinth can absorb dissolved toxic chemicals such as cadmium and other such elements. Establishing these in regions prone to such kinds of pollutants will reduce the adverse effects to a large extent.

Some chemical methods that help in the control of water pollution are precipitation, the ion exchange process, reverse osmosis, and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution.

Government Policies

- **Namami Gange Programme:** The **Namami Gange Programme** is India's flagship initiative to **clean and rejuvenate the River Ganga** and its important tributaries. Launched by the Government of India in **June 2014**, this mission was approved with an initial budget of **Rs 20,000 crore** and later extended with additional funds, reaching close to about **Rs 22,500 crore through March 2026**. It is implemented by the **National Mission for Clean Ganga (NMCG)** under the **Ministry of Jal Shakti**.
- **National River Conservation Plan (NRCP):** The **National River Conservation Plan (NRCP)** is an earlier centrally sponsored water pollution control scheme that predates Namami Gange and provides an overall framework for cleaning polluted stretches of **major rivers across India**. It evolved from the **Ganga Action Plan (1985)** to cover other important rivers and is overseen by the **National River Conservation Directorate (NRCD)** under the **Ministry of Jal Shakti**.
- **Jal Jeevan Mission:** The **Jal Jeevan Mission (JJM)** also popularly known as "**Har Ghar Jal**" is a flagship rural water supply initiative that was launched by the Government of India on **15th August 2019**. The primary purpose of this mission is to **ensure access to safe and potable drinking water** for all rural households through **functional household tap connections (FHTCs)**. It originally aimed for **100% rural tap water coverage by 2024**, but the deadline has now been extended to **2028** with

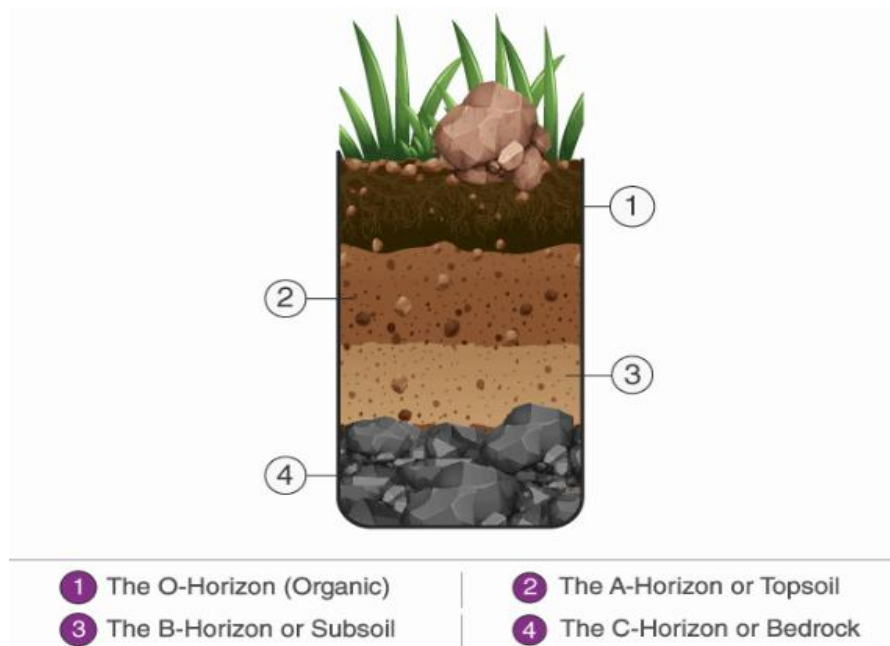
continued financial support, recognizing that complete coverage and sustained water quality.

3. Soil Pollution: Soil pollution, also called soil contamination, refers to the degradation of land due to the presence of chemicals or other man-made substances in the soil. It degrades soil quality, reduces fertility, and disrupts soil biodiversity, allowing pollutants to enter food chains or contaminate groundwater through leaching.



Soil Profile

The soil is the topmost layer of the earth's crust mainly composed of organic minerals and rock particles that support life. A soil profile is a vertical cross-section of the soil, made of layers running parallel to the surface. These layers are known as soil horizons.

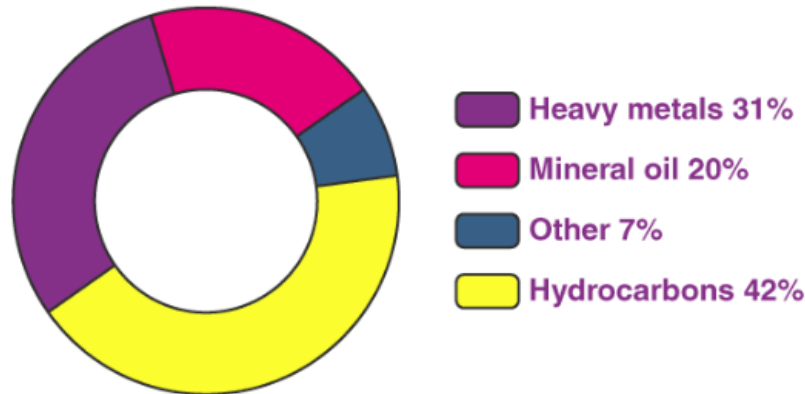


Causes of Soil Pollution

- Improper industrial waste disposal
- Oil Spills
- Acid Rain which is caused by air pollution
- Mining Activities
- Intensive farming and uses of agrochemicals (i.e. chemicals and fertilizers)
- Industrial accidents

What are the Pollutants that Contaminates Soil?

Some of the most hazardous soil pollutants are xenobiotics substances that are not naturally found in nature and are synthesized by human beings. The term ‘xenobiotic’ has Greek roots – ‘Xenos’ (foreigner), and ‘Bios’ (life). Several xenobiotics are known to be carcinogens. An illustration detailing major soil pollutants is provided below.



Effects of Soil Pollution: Soil has an impact on almost every aspect of our daily lives. We don't always understand it. As a result, we sometimes fail to recognise the impact of soil pollution on our daily lives. Polluted soil can result in stunted crops or even a toxic underground water table.

- **Effect on Health of Human:** soil is the reason we can sustain ourselves; its contamination has serious consequences for our health. Crops and plants grown in polluted soil absorb a large portion of the pollution and pass it on to us. This could account for the sudden increase in minor and terminal illnesses. Long-term exposure to such soil can change the genetic make-up of the body, resulting in congenital illnesses and chronic health problems that are difficult to treat.
- **Effect on Growth of Plants:** The widespread contamination of the soil has an impact on the ecological balance of any system. When the chemistry of the soil changes so dramatically in such a short period of time, most plants are unable to adapt. Fungi and bacteria found in soil that bind it together begin to decline, adding to the problem of soil erosion. The fertility of the soil gradually declines, rendering the land unsuitable for agriculture and the survival of any local vegetation.
- **Deceased Soil Fertility:** Toxic chemicals in the soil can reduce soil fertility, resulting in a decrease in soil yield. The contaminated soil is then used to grow fruits and vegetables that are deficient in nutrients and may contain a poisonous substance that causes serious health problems in those who consume them.
- **Change in Soil Structure:** The death of many soil organisms (for example, earthworms) in the soil can cause changes in soil structure. Aside from that, it could force other predators to relocate in search of food. A number of solutions have been proposed to reduce the current rate of pollution. Such As are the efforts to clean up the environment necessitate a significant investment of time and the resources. Organic

farming methods are being promoted, which avoid the use of chemical-laden pesticides and fertilisers.

Control of Soil Pollution

- **Soil erosion** can be controlled by a variety of forestry and farm practices also Contour cultivation and strip cropping may be practiced instead of shifting cultivation. For example: Planting trees on barren slopes.
- **Proper dumping of unwanted materials:** Excess wastes by man and animals pose a disposal problem. Open dumping is the most commonly practiced technique. Nowadays, controlled tipping is followed for solid waste disposal. The surface so obtained is used for housing or sports field.
- **Production of natural fertilizers:** Bio-pesticides should be used in place of toxic chemical pesticides. Organic fertilizers should be used in place of synthesized chemical fertilizers. For example: Organic wastes in animal dung may be used to prepare compost manure instead of throwing them wastefully and polluting the soil.
- **Proper hygienic condition:** People should be trained regarding sanitary habits. For example: Lavatories should be equipped with quick and effective disposal methods.
- **Public awareness:** Informal and formal public awareness programs should be imparted to educate people on health hazards by environmental education. For example: Mass media, Educational institutions and voluntary agencies can achieve this.
- **Recycling and Reuse of wastes:** To minimize soil pollution, the wastes such as paper, plastics, metals, glasses, organics, petroleum products and industrial effluents etc should be recycled and reused. For example: Industrial wastes should be properly treated at source. Integrated waste treatment methods should be adopted.
- **Ban on Toxic chemicals:** Ban should be imposed on chemicals and pesticides like DDT, BHC, etc which are fatal to plants and animals. Nuclear explosions and improper disposal of radioactive wastes should be banned.

Example of Soil Pollution: A very current example of soil pollution involves the widespread contamination from discarded COVID-19 protective gear (masks, gloves) and disinfectants, alongside persistent issues like microplastics from consumer waste, heavy metals from industry/mining (like cadmium, lead), and agricultural runoff from excessive fertilizers/pesticides, all disrupting soil health, entering food chains, and posing risks to biodiversity and human health, as highlighted by the UN and FAO.

Government Policies:

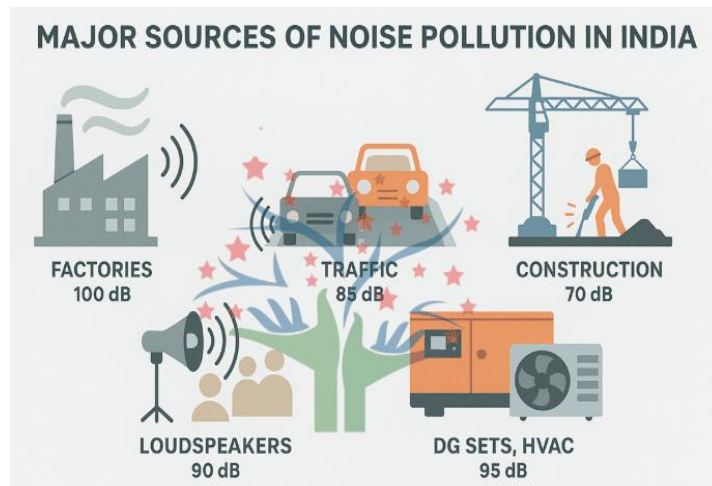
- **Swachh Bharat Mission (Urban & Rural):** The **Swachh Bharat Mission (SBM)** is one of India's largest cleanliness and waste management programmes, launched on **2 October 2014** by the Government of India. It operates in two parts: **Swachh Bharat Mission (Urban)** under the Ministry of Housing and Urban Affairs.
- **Plastic Waste Management Rules, 2016 (Amended):** The **Plastic Waste Management Rules, 2016**, notified under the **Environment (Protection) Act, 1986**, provide a comprehensive legal framework to manage plastic waste in an environmentally sound manner. These rules were a significant improvement over earlier regulations and have been **amended multiple times**, notably in **2021 and 2022**, to address growing plastic pollution concerns. One of the key provisions of these rules is the **ban on identified single-use plastic items**.
- **E-Waste Management Rules:** The **E-Waste Management Rules** were first introduced in **2016** and later replaced by the **E-Waste Management Rules, 2022**, which came into effect in **April 2023**. These rules regulate the handling, collection, recycling, and disposal of **electronic waste**, such as discarded computers, mobile phones, televisions, batteries, and other electrical equipment. Electronic waste contains **hazardous substances** like lead, mercury, cadmium, and brominated flame retardants, which can cause serious **soil and water contamination** if disposed of improperly.

4. Noise Pollution: **Noise pollution** refers to the excessive amount of noise in the surrounding that disrupts the natural balance. Usually, it is man-made, though certain natural calamities like volcanoes can contribute to noise pollution. In general, any sound which is over 85 decibels is considered to be detrimental. Also, the duration an individual is exposed plays an impact on their health. **The intensity of sound is measured in decibels (dB).**



Types of Noise Pollution

- **Transport Noise:** It mainly consists of traffic noise which has increased in recent years with the increase in the number of vehicles. The increase in noise pollution leads to deafening of older people, headache, hypertension, etc.
- **Neighbourhood Noise:** The noise from gadgets, household utensils etc. Some of the main sources are musical instruments, transistors, loudspeakers, etc.
- **Industrial Noise:** It is the high-intensity sound which is caused by heavy industrial machines. According to many researches, industrial noise pollution damages the hearing ability to around 20%.



Causes and Sources of Noise Pollution

- **Industrialization:** Industrialisation has led to an increase in noise pollution as the use of heavy machinery such as generators, mills, huge exhaust fans are used, resulting in the production of unwanted noise.
- **Vehicles:** Increased number of vehicles on the roads are the second reason for noise pollution.
- **Events:** Weddings, public gatherings involve loudspeakers to play music resulting in the production of unwanted noise in the neighbourhood.
- **Construction Site:** Mining, construction of buildings, etc add to the noise pollution.

Effects of Noise Pollution on Human Health

- **Hypertension:** It is a direct result of noise pollution which is caused due to elevated blood levels for a longer duration.
- **Hearing Loss:** Constant exposure of human ears to loud noise that are beyond the range of sound that human ears can withstand damages the eardrums, resulting in loss of hearing.
- **Sleeping Disorder:** Lack of sleep might result in fatigue and low energy level throughout the day affecting everyday activities. Noise pollution hampers the sleep cycles leading to irritation and an uncomfortable state of mind.
- **Cardiovascular Issues:** Heart-related problems such as blood pressure level, stress and cardiovascular diseases might come up in a normal person and a person suffering from any of these diseases might feel a sudden shoot up in the level.

Prevention of Noise Pollution

Some noise pollution prevention measures are provided in the points below.

- Honking in public places like teaching institutes, hospitals, etc. should be banned.
- In commercial, hospital, and industrial buildings, adequate soundproof systems should be installed.
- Musical instruments' sound should be controlled to desirable limits.
- Dense tree cover is useful in noise pollution prevention.

- Explosives should not be used in forest, mountainous and mining areas.

World Health Organization (WHO) guidelines for Noise Pollution

The World Health Organization (WHO) has developed comprehensive noise guidelines based on extensive research into noise-related health effects. For residential areas during daytime hours, WHO recommends that noise levels should not exceed 55 dBA for outdoor areas and 35 dBA for indoor spaces. During night-time hours, these limits become even more stringent: 40 dBA outdoors and 30 dBA indoors to protect sleep quality.

For schools and educational facilities, WHO recommends maximum noise levels of 35 dBA in classrooms during teaching hours, recognizing that excessive noise can significantly impair learning and cognitive development. Hospital settings have even stricter standards, with recommended levels of 30 dBA during daytime and 25 dBA at night to support patient recovery.

India's Central Pollution Control Board (CPCB) Standards

The Central Pollution Control Board (CPCB) of India has established noise standards that consider the country's diverse environmental contexts. These standards recognize four main area categories: industrial, commercial, residential, and silence zones.

Industrial areas have the most lenient standards allowing up to 75 dBA during day hours (6 AM to 10 PM) and 70 dBA during night hours. **Commercial areas** are limited to 65 dBA during day hours and 55 dBA at night. **Residential areas** have stricter limits of 55 dBA during day hours and 45 dBA at night. **Silence zones**, which include areas around hospitals, schools, and courts, have the most stringent standards: 50 dBA during day hours and 40 dBA at night.

Government Polices

- **Noise Pollution Control:** The **Noise Pollution (Regulation and Control) Rules, 2000** were introduced by the Government of India under the **Environment (Protection) Act, 1986** to control and reduce noise pollution and protect public health. These rules define permissible noise limits for different areas such as **residential zones, commercial zones, industrial zones, and silence zones** (areas around schools, hospitals, courts, and educational institutions).

Under these rules, the use of **loudspeakers, public address systems, and sound-producing instruments** is regulated. Permission from local authorities is required, and loudspeakers are strictly prohibited between **10:00 pm and 6:00 am**, except during special occasions approved by the government.

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