Climate Change

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods

Climate Change and its implications for India:

The future impacts of climate change, identified by the Government of India include:

- Decreased snow cover, affecting snow-fed and glacial systems such as the Ganges and Brahmaputra. 70% of the summer flow of the Ganges comes from melt water
- Erratic monsoon with serious effects on rain-fed agriculture, peninsular rivers, water and power supply
- Drop in wheat production by 4-5 million tones, with even a 1ºC rise in temperature
- Rising sea levels causing displacement along one of the most densely populated coastlines in the world, threatened freshwater sources and mangrove ecosystems
- Increased frequency and intensity of floods. Increased vulnerability of people in coastal, arid and semi-arid zones of the country
- Studies indicate that over 50% of India's forests are likely to experience shift in forest types, adversely impacting associated biodiversity, regional climate dynamics as well as livelihoods based on forest products.

Response to Climate Change:

There are two main policy responses to climate change:

- Mitigation
- Adaptation

Mitigation addresses the root causes, by reducing greenhouse gas emissions, while adaptation seeks to lower the risks posed by the consequences of climatic changes. Both approaches will be necessary, because even if emissions are dramatically decreased in the next decade, adaptation will still be needed to deal with the global changes that have already been set in motion.

Adaptation measures may be planned in advance or put in place spontaneously in response to a local pressure. They include large-scale infrastructure changes – such as building defenses to protect against sea-level rise or improving the quality of road surfaces to withstand hotter temperatures – as well behavioral shifts such as individuals using less water, farmers planting different crops and more households and businesses buying flood insurance.

The IPCC describes vulnerability to climate change as being determined by three factors: exposure to hazards (such as reduced rainfall), sensitivity to those hazards (such as an economy dominated by rain-fed agriculture), and the capacity to adapt to those hazards (for example, whether farmers have the money or skills to grow more drought-resistant crops). Adaptation measures can help reduce vulnerability – for example by lowering sensitivity or building adaptive capacity – as well as allowing populations to benefit from opportunities of climatic changes, such as growing new crops in areas that were previously unsuitable.

Low-income countries tend to be more vulnerable to climate risks and some adaptation measures – such as increasing access to education and health facilities – will overlap with existing development programmes. But adaptation goes beyond just development to include measures to address additional risks specifically caused by climate change, such as raising the height of sea defenses. It is still unclear how expensive these measures

will be or who will pay for them, but the World Bank suggests adaptation could cost the same again as the world currently spends on development assistance.

Indian response to Climate Change:

NATIONAL ACTION PLAN ON CLIMATE CHANGE (NAPCC)

- On June 30, 2008, Prime Minister Manmohan Singh released India's first National Action Plan on Climate Change (NAPCC) outlining existing and future policies and programs addressing climate mitigation and adaptation.
- The plan identifies eight core "national missions" running through 2017 and directs ministries to submit detailed implementation plans to the Prime Minister's Council on Climate Change.
- Emphasizing the overriding priority of maintaining high economic growth rates to raise living standards, the plan "identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively."
- It says these national measures would be more successful with assistance from developed countries, and pledges that India's per capita greenhouse gas emissions "will at no point exceed that of developed countries even as we pursue our development objectives."

National Missions

National Solar Mission: The NAPCC aims to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options. The plan includes:

- Specific goals for increasing use of solar thermal technologies in urban areas, industry, and commercial establishments;
- Produce 22,000 Megawatts of Solar Energy by the year 2022.
- A goal of increasing production of photovoltaic to 1000 MW/year; and
- A goal of deploying at least 1000 MW of solar thermal power generation. Other objectives include the establishment of a solar research center, increased international collaboration on technology development, strengthening of domestic manufacturing capacity, and increased government funding and international support.

National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012. Building on the Energy Conservation Act 2001, the plan recommends:

- Mandating specific energy consumption decreases in large energy-consuming industries, with a system for companies to trade energy-savings certificates;
- Energy incentives, including reduced taxes on energy-efficient appliances; and
- Financing for public-private partnerships to reduce energy consumption through demand-side management programs in the municipal, buildings and agricultural sectors.

National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning, the plan calls for:

- Extending the existing Energy Conservation Building Code;
- A greater emphasis on urban waste management and recycling, including power production from waste;
- Strengthening the enforcement of automotive fuel economy standards and using pricing measures to encourage the purchase of efficient vehicles; and

- Incentives for the use of public transportation.

National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20% improvement in water use efficiency through pricing and other measures.

National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.

National Mission for a "Green India": Goals include the afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23% to 33% of India's territory.

National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.

National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modeling, and increased international collaboration. It also encourage private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

Other Programs

The NAPCC also describes other ongoing initiatives, including:

- Power Generation: The government is mandating the retirement of inefficient coal-fired power plants and supporting the research and development of IGCC and supercritical technologies.
- Renewable Energy: Under the Electricity Act 2003 and the National Tariff Policy 2006, the central and the state electricity regulatory commissions must purchase a certain percentage of grid-based power from renewable sources.
- Energy Efficiency: Under the Energy Conservation Act 2001, large energy-consuming industries are required to undertake energy audits and an energy labeling program for appliances has been introduced.

POLLUTION

Definition: Pollution is the effect of *undesirable changes* in our surroundings that have harmful effects on plants, animals and human beings.

Pollutants: Pollutants include solid, liquid or gaseous sub-stances present in greater than natural abun-dance produced due to human activity, which have a detrimental effect on our environment.

From an ecological perspective pollutants can be classified as follows:

1. *Degradable or non-persistent pollutants:* These can be rapidly broken down by natural processes. Eg: domestic sewage, discarded vegetables, etc.
2. *Slowly degradable or persistent pollutants*: Pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade. Eg: DDT, Endosulfan which is POP (Persistent Organic Pollutant) and most plastics.

3. *Non-degradable pollutants:* These cannot be degraded by natural processes. Once they are released into the environment they are difficult to eradicate and continue to accumulate. Eg: toxic elements like lead or mercury

Pollution can be further categorized into:

- Soil Pollution
- Air Pollution
- Water Pollution
- Marine Pollution
- Noise Pollution
- Thermal Pollution
- Nuclear Hazards

SOIL POLLUTION

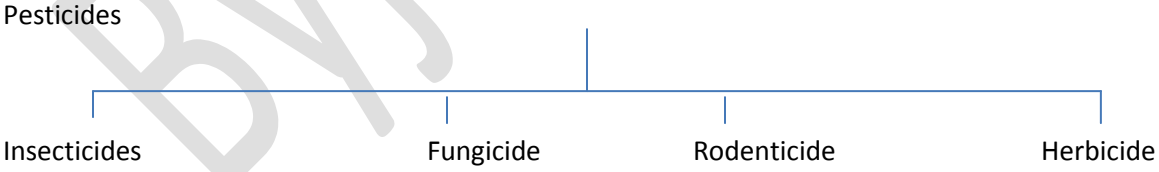
There are 4 different layers of soils on surface of the Earth:

1. O-Horizon - The top layer or the surface litter layer called the O horizon consists mostly of freshly fallen and partially decomposed leaves, twigs, animal waste, fungi and other organic materials. Normally it is brown or black.
2. Horizon or Top soil- The uppermost layer of the soil called the A horizon consists of partially decomposed organic matter (humus) and some inorganic mineral particles. It is usually darker and looser than the deeper layers. The roots of most plants are found in these two upper layers.
3. Horizon or Sub soil: The B horizon often called the subsoil contains less organic material and fewer organisms than the A horizon.
4. Horizon - It contains weathered parent materials. This parent material does not contain any organic materials.

Causes of soil degradation:

1. Erosion
    a. Gully erosion
    b. Sheet erosion
2. Excess use of fertilizers AND pesticides

Pesticides



Some specific problems associated with the use of pesticides:

Bioaccumulation:

Persistent pesticides may also accumulate in the bodies of animals, and over a period of time increase in concentration if the animal is unable to flush them out of its system thus leading to the phenomenon called bioaccumulation.

Biomagnifications:

When an affected animal is eaten by another carnivore these pesticides are further concentrated in the body of the carnivore. This phenomenon of acquiring increasing levels of a substance in the bodies of higher trophic level organisms is known as bio-magnification. This process especially in the case of insecticide like DDT has been proved to be disastrous. DDT is a well known case of bio-magnification in ecosystems.

3. Excess salts and water

WATER POLLUTION

Definition: When the quality or composition of water changes directly or indirectly as a result of man's activities such that it becomes unfit for any purpose it is said to be polluted.

Point sources and Non-point sources of pollution: When a source of pollution can be readily identified because it has a definite source and place where it enters the water it is said to come from a point source. Eg. Municipal and Industrial Discharge Pipes. When a source of pollution cannot be readily identified, such as agricultural runoff, acid rain, etc, they are said to be non-point sources of pollution.

Causes of water pollution are:

1. *Disease-causing agents (pathogens)*: which include bacteria, viruses, protozoa and parasitic worms that enter water from domestic sewage and untreated human and animal waste. Human wastes contain concentrated populations of coliform bacteria such as Escherichia coli and Streptococcus faecalis. These bacteria normally grow in the large intestine of humans where they are responsible for some food digestion and for the production of vitamin K. These bacteria are not harmful in low numbers. Large amounts of human waste in water, increases the number of these bacteria which cause gastrointestinal diseases. Other potentially harmful bacteria from human wastes may also be present in smaller numbers.
2. *Oxygen depleting wastes:* These are organic wastes that can be decomposed by aerobic (oxygen requiring) bacteria. Large populations of bacteria use up the oxygen present in water to degrade these wastes. In the process this degrades water quality. The amount of oxygen required to break down a certain amount of organic matter is called the **biological oxygen demand (BOD).** The amount of BOD in the water is an indicator of the level of pollution. If too much organic matter is added to the water all the available oxygen is used up. This causes fish and other forms of oxygen dependent aquatic life to die. Thus anaerobic bacteria (those that do not require oxygen) begin to break down the wastes. Their anaerobic respiration produces chemicals that have a foul odour and an unpleasant taste that is harmful to human health.
3. *Inorganic plant nutrients:* These are water soluble nitrates and phosphates that cause excessive growth of algae and other aquatic plants. The excessive growth of algae and aquatic plants due to added nutrients is called **eutrophication**. Excess use of fertilizers is one of the major cause of eutrophication.
4. *Water soluble inorganic chemicals* which are acids, salts and compounds of toxic metals such as mercury and lead.
5. *Organic chemicals*
6. *Sediment of suspended matter*

MARINE POLLUTION

Definition: Marine pollution can be defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as hazards to human health, obstruction of

marine activities and lowering the quality of sea water. While the causes of marine pollution may be similar to that of general water pollution there are some very specific causes that pollute marine waters.

- The most obvious inputs of waste is through pipes directly discharging wastes into the sea. Very often municipal waste and sew-age from residences and hotels in coastal towns are directly discharged into the sea.
- Pesticides and fertilizers from agriculture which are washed off the land by rain, enter water courses and eventually reach the sea.
- Petroleum and oils washed off from the roads normally enter the sewage system but storm water overflows carry these materials into rivers and eventually into the seas.
- Ships carry many toxic substances such as oil, liquefied natural gas, pesticides, industrial chemicals, etc. in huge quantities some-times to the capacity of 350,000 tonnes. Ship accidents and accidental spillages at sea therefore can be very damaging to the marine environment. Shipping channels in estuaries and at the entrances to ports often require frequent dredging to keep them open. This dredged material that may contain heavy metals and other contaminants are often dumped out to sea.
- Offshore oil exploration and extraction also pollute the seawater to a large extent.

AIR POLLUTION

- Air pollution occurs due to the presence of un-desirable solid or gaseous particles in the air in quantities that are harmful to human health and the environment. Air may get polluted by natural causes such as volcanoes, which release ash, dust, sulfur and other gases, or by forest fires that are occasionally naturally caused by lightning.
- Pollutants that are emitted directly from identifiable sources are produced both by natural events (for example, dust storms and volcanic eruptions) and human activities (emission from vehicles, industries, etc.). These are called primary pollutants.
- There are five primary pollutants that together contribute about 90 percent of the global air pollution. These are carbon oxides (CO and CO2), nitrogen oxides, sulfur oxides, volatile organic compounds (mostly hydrocarbons) and suspended particulate matter.
- Pollutants that are produced in the atmosphere when certain chemical reactions take place among the primary pollutants are called secondary pollutants. Eg: sulfuric acid, nitric acid, carbonic acid, etc.

Pollutants	**Source**
Carbon monoxide	Incomplete combustion of organic material
Sulfur oxides	Sulfur containing fossil fuels are burnt
Nitrogen oxides	Vehicular exhausts
Hydrocarbons	Evaporates from fuel supplies or remnants of fuel that didn't burn completely
Particulates	Smoke particles from fires, bits of asbestos, dust particles and ash from industries
Lead	Emitted by vehicles due to leaded petrol

Particulate matter

Particulates are small pieces of solid material dispersed into the atmosphere. The effects of particulates range from soot to the carcinogenic (cancer causing) effects of asbestos, dust particles and ash from

industrial plants that are dispersed into the atmosphere. Repeated exposure to particulates can cause them to accumulate in the lungs and interfere with the ability of the lungs to exchange gases.

Types of particulates

Term	Meaning	Examples
Aerosol	General term for particles suspended in air	Sprays from pressurized cans
Mist	Aerosol consisting of liquid droplets	Sulfuric acid mist
Dust	Aerosol consisting of solid particles that are blown into the air or are produced from larger particles by grinding them down	Dust storm
Smoke	Aerosol consisting of solid particles or a mixture of solid and liquid particles produced by chemical reaction such as fires	Cigarette smoke, smoke from burning garbage
Fume	Generally means the same as smoke but often applies specifically to aerosols produced by condensation of hot vapors of metals.	Zinc/lead fumes
Plume	Geometrical shape or form of the smoke coming out of a chimney	
Fog	Aerosol consisting of water droplets	
Smog	Term used to describe a mixture of smoke and fog.	

Effects of air pollution on atmosphere:

- Ozone layer depletion
- Green House effect

NOISE POLLUTION

Noise is undesirable and unwanted sound. 125-130 dB is consider as the limit above which any sound is not safe for the auditory system of any Human being.

Effects of noise pollution on human health:

The most direct harmful effect of excessive noise is physical damage to the ear and the temporary or permanent hearing loss often called a *temporary threshold shift (TTS)*. People suffering from this condition are unable to detect weak sounds. However hearing ability is usually recovered within a month of exposure. Permanent loss, usually called *noise induced permanent threshold shift (NIPTS)* represents a loss of hearing ability from which there is no recovery. Below a sound level of 80 dB haring loss does not occur at all. However temporary effects are noticed at sound levels between 80 and 130 dB. About 50 percent of

the people exposed to 95 dB sound levels at work will develop NIPTS and most people exposed to more than 105 dB will experience permanent hearing loss to some degree. A sound level of 150 dB or more can physically rupture the human eardrum. Noise can also cause emotional or psychological effects such as irritability, anxiety and stress. Lack of concentration and mental fatigue are significant health effects of noise.

Decibel levels of common sounds

dB	Environmental Condition
0	Threshold of hearing
10	Rustle of leaves
20	Broadcasting studio
30	Bedroom at night
40	Library
50	Quiet office
60	Conversational speech (at 1m)
70	Average radio
74	Light traffic noise
90	Subway train
100	Symphony orchestra
110	Rock band
120	Aircraft takeoff
146	Threshold of pain

THERMAL POLLUTION

The discharge of warm water into a river is usually called a thermal pollution. It occurs when an industry removes water from a source, uses the water for cooling purposes and then returns the heated water to its source.

SOLID WASTE MANAGEMENT of URBAN AND INDUSTRIAL WASTE:

Control measures of urban and industrial wastes: An integrated waste management strategy includes three main components:

1. Source reduction
2. Recycling
3. Disposal: Disposal of solid waste is done most commonly through a sanitary landfill or through incineration.

Multilateral treaties to curb pollution

***Rotterdam convention*:**

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, more commonly known simply as the Rotterdam Convention, is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The

convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged make sure that producers within their jurisdiction comply.

Stockholm convention on Persistent Organic Pollutants (POP):

It is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). Endosulfan was recently banned by it.

Basel convention:

The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, usually known as the Basel Convention, is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.