

Contents

- 
1. Introduction
 2. The Pressure of Population
 3. Impacts of Population Pressure on Environment:
 4. Air Pollution
 5. Air pollutants
 6. Primary Air pollutants
 7. Secondary Air Pollutants
 8. Issues with Ground Level Ozone
 9. Smog
 10. Problem of Persistent organic pollutants (POPs)
 11. Deaths due to Air Pollution
 12. Top CO2 emitting countries
 13. Highest Per Capita CO2 emission
 14. Basics of Carbon Cycle
 15. Global Carbon Budget
 16. Ocean Acidification
 17. Acid Rains
 18. Flue Gas Desulphurization (FGD)
 19. Convention on Long-Range Transboundary Air Pollution (CLRTAP)
 20. Sulphur Emissions Reduction Protocol
 21. Gothenburg protocol
 22. Acid Rain Program
 23. Greenhouse Gases (GHGs)
 24. Forcing GHGs
 25. GHG by sectors
 26. Green House Effect
 27. Anti-greenhouse effect
 28. Basics of Climate Change
 29. How Climate can be predicted but not Weather?
 30. Climate Feedback and Polar amplification
 31. Carbon Footprint
 32. Carbon Offsetting
 33. Carbon sequestration
 34. Oxygen Minimum Zone (OMZ)
 35. Dead Zones
 36. Global dimming
 37. Eutrophication
 38. Air Quality Index (AQI) & SAFAR
 39. Emission Standards : BS III
 40. Emissions Trading
 41. Aarhus Convention
 42. Espoo Convention
 43. Earth Summit 1992
 44. Foundation of Green Cross International
 45. Rio Declaration on Environment and Development
 46. Agenda 21
 47. Convention on Biological Diversity
 48. Nagoya Protocol
 49. India and Nagoya Protocol
 50. Access Benefit Sharing & India's Standpoint
 51. India and Biodiversity
 52. National Biodiversity Action Plan
 53. Biological Diversity Act
 54. Like Minded Megadiverse Countries (LMMCs)
 55. Centre for Biodiversity Policy and Law (CEBPOL)
 56. United Nations Framework Convention on Climate Change
 57. Conference of Parties→COP 1 to COP 3
 58. Kyoto Protocol
 59. Kyoto mechanisms
 60. COP 4 to COP 15
 61. India & the Kyoto Protocol
 62. Kyoto Units
 63. Certified Emission Reductions (CERs)
 64. Joint Implementation
 65. Clean Development Mechanism
 66. Programme of Activities (PoA)
 67. Bachat Lamp Yojna as a PoA
 68. Carbon Leakage
 69. Bali Action Plan
 70. Carbon Tax
 71. Pigou Club
 72. Depletion of Ozone Layer
 73. Vienna Convention
 74. Montreal Protocol 1989
 75. Persistent Organic Pollutants (POPs)
 76. Bio-accumulation, Bio-concentration and Bio-magnification
 77. Biomagnification
 78. Stockholm Convention on Persistent Organic Pollutants
 79. Mayee committee of Kerala
 80. Hazardous substances
 81. International Programme on Chemical Safety
 82. Rotterdam Convention
 83. Marine Pollution
 84. London Convention
 85. Cultural Eutrophication
 86. Mercury Poisoning in Fishes
 87. Minimata Disease
 88. Oil Spills
 89. Bioremediation
 90. Oil Zapper
 91. Largest Oil Spills
 92. United Nations Convention on the Law of the Sea (UNCLOS)
 93. UNCLOS and problem of Arctic
 94. Marine Protected Area
 95. India and Marine Protected Areas
 96. International Convention for the Regulation of Whaling
 97. Wadden Sea Agreement
 98. ACCOBAMS
 99. MARPOL 73/78

Introduction

Ever since its emergence about 3 million years ago, the humankind has adapted and is adapting to various environment zones in the tropical and temperate regions of the world. From the Prehistoric times till the modern hominids have been constantly interacting with their respective local environments, but the nature of this interaction has registered a dramatic change over the period of time.

👉 The **beginning of Neolithic period marked the domestication of plants and animals** and interaction of the Humans with their environments started taking varied shapes.

The demographic expansion of the human population coupled with the technological developments from historic to modern times resulted in the increasing intensity of natural resources exploitation.

The degradation of the tropical forest ecosystems, which was preserving the rich genetic diversity of plants, animals and micro-organisms, became the cause of the shrinking biodiversity and this was the major issue in the **Rio Earth Summit, Brazil in 1992**.

👉 After the **Rio Summit of 1992**, we have seen a **dangerous trend** of "eco-imperialism" sneaking slowly and steadily into the geopolitics.

Whether it's an issue of environment protection or sustainable development or protection of the biodiversity or climate change and Global warming, the whole world seems to be **divided into two blocks**.

👉 One is the block of the developed countries which are rich in technology but poor in biodiversity.

👉 Other is the block of the least developed, underdeveloped and developing countries which are rich in the environment biodiversity but poor in resources and are in want of technology for development.

The Pressure of Population

The population of the World has increased ever after. Today the estimated population of the World is 6,899,400,000 and as per the current estimations World population is expected to reach between 7.5 and 10.5 billion in the year 2050.

The following table shows the Milestones of the world population.

Population	1	2	3	4	5	6	7	8	9
Year	1804	1927	1960	1974	1987	1999	2012	2025-2030	2045-50
Years elapsed	123	33	14	13	12	13	15-20	20-25	
Figures in Billion.									

We see from the above table that

1. Time elapsed from 1 billion to 2 billion was maximum i.e. 123 years.
2. This elapsing time decreased till 1999, when Population became 6 Billion.
3. The projected time elapsed is now increasing till the population becomes 9 Billion.

Black Death

We all know that the growth of the Human Population and increased use of resources is having a large effect on earth. In **Europe** between 1348 to 1350, there was most **devastating pandemic** which was mainly because of the **Bubonic Plague**. This pandemic started from China and killed almost **30-60% of the population of Europe** and is called the "Black Death". At that time the estimated population of the world was 450 million and it got reduced to 350-375 million in 1400.

Impacts of Population Pressure on Environment:

The increasing population Pressure caused the **pollution** of air, water, soil and destruction of the habitats. This led to the reduction of the biodiversity and due to the population pressure there has always a conflict between the conservation measures and the interests of the local people.

- As the new tools and weapons were developed, the hunting and harvesting led to extinction of many species such as **Dodo**, (*Raphus cucullatus*), which was **endemic to Mauritius** and got wiped out in the late 17th century. The extinct bird still is the **national symbol** of Mauritius.
- The development of agriculture continues to lead the removal of the natural vegetation over huge areas to make room for growth of the crops. The consistent use of pesticides, herbicides and fertilizers has affected the natural organisms.
- The industrial revolution has led to an upsurge in the demand for energy and other resources, which increased the amount of land disturbed by the extraction of materials such as fossil fuels, metal ores, and gravel. More fossil fuels were burnt, releasing large amounts of gases such as carbon dioxide, sulphur dioxide, and nitrogen oxides into the atmosphere.
- The growing human population, the expectation of better living conditions, and easier transport, has led to the building of larger cities and more roads. Pollution of water, land, and air by human wastes and exhaust gases from vehicles has increased.

Air Pollution

Introduction of **chemicals**, **particulate** matter, **biological** materials which cause harm or discomfort to humans or other living organisms, and cause damage to the natural environment is Air Pollution. The **Stratospheric ozone depletion** due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems. Some of the air pollutants such as carbon dioxide, methane and water vapor absorb the long wave radiation and prevent much of it from passing out and away from the earth. They create a blanket around the earth and therefore keep the air and the ground warmer than it would otherwise be. The effect is known as Green House Effect. The Gases which cause this effect are called GHGs (Green House Gases). Green House Effect has led to the Global Warming.

Air pollutants

The Air Pollutants can be solid particles, liquid droplets, or gases. They can be natural or manmade. The pollutants have been classified into primary and secondary categories.

- The **primary pollutants** are "**directly**" **emitted** from the processes such as fossil fuel consumption, Volcanic eruption and factories.
- The **secondary pollutants** are not emitted directly. The secondary pollutants form when the **primary pollutants react with themselves** or other components of the atmosphere.

Primary Air pollutants

The major primary pollutants are **Sulphur oxides**, **Nitrogen Oxides**, **Carbon dioxide**, **particulate matter**, **Methane**, **Ammonia**, **Chlorofluorocarbons**, **Toxic metals** etc.

- ✓ The **Sulphur Oxides** are generally a product of the **Volcanoes**, **Industrial processes**, **Coal and petroleum**, because most of them have Sulphur as a component. The Sulphur Dioxide in presence of a catalyst such as NO₂ causes **Acid Rain**, because of the formation of Sulphuric Acid.

- ✓ Most of the **Nitrogen Oxides** are produced due to **high temperature combustion**. In the cities the brown haze dome above the cities is mostly because of the Nitrogen Oxides. The most important toxic gas is Nitrogen dioxide which is brown, with sharp odor.
- ✓ **Carbon Monoxide**, which is colorless, odorless and non irritating but very poisonous gas is the product of **incomplete combustion** of the **natural gas, coal or wood**. The **vehicle exhaust** is the **major source** of CO.
- ✓ The **Carbon Dioxide is associated with the Ocean Acidification** and is emitted from combustion, factories and respiration of living organisms.
- ✓ Then, we have primary pollutants such as **Volatile Organic Compounds or VOCs** which are **methane** (CH₄) and **non-methane** (NMVOCs).
- ✓ Methane is a GHG which contributes to Global Warming.
- ✓ The **NMVOCs** include the aromatic compounds such as **benzene, Toluene, Xylene** which are proved and suspected **carcinogens**. Another dangerous compound is the **1,3-butadiene**, often associated with industrial uses.
- ✓ The **particulate matters** are the fine particles which may be either **solid or liquid, suspended in a gas**. They are different from the Aerosols. Aerosols are particle and gas referred together.
- ✓ The aerosols which are created by the Human activities are **anthropogenic aerosols**. They account for around 10% of the total aerosols in the atmosphere.
- ✓ Then we have **toxic metals as primary pollutants** such as **Cadmium, Lead and Copper**, which are products of the Industrial processes.
- ✓ The Chlorofluorocarbons (CFCs) are proved to be harmful to the ozone layer emitted from products currently banned from use.
- ✓ In **agriculture** process, **Ammonia is emitted which has characteristic pungent odor**. It is a precursor to foodstuffs and fertilizers. Ammonia is also a building block for the synthesis of many pharmaceuticals.

Secondary Air Pollutants

Most important secondary level Air Pollutants are **Ground Level Ozone, Smog and POPs** . They are discussed in brief in the following pages.

Issues with Ground Level Ozone

The most important secondary pollutant is the **Ground Level Ozone**. Ground Level Ozone is **formed** from the **Nitrogen Oxides, CO** and **Volatile Organic Compounds** (VOCs). The Ground Level Ozone is **also called** the **Tropospheric Ozone**.

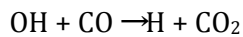
- 👉 It is caused when the nitrogen oxides (NO_x), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs) and NMVOCs such as Xylene react in the atmosphere in the presence of sunlight.
- 👉 The Precursors to the Ground Level Ozone are NO_x, CO, and VOCs.
- 👉 In the last 100 years the emission of Methane, which is a Volatile Organic Compound has increased dramatically and it has contributed to the Ground Level Ozone formation.

How Ground Level Ozone is formed?

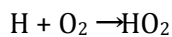
It involves a long complex series of the reactions in which carbon monoxide and VOCs are oxidized to water vapor and carbon dioxide. The series of the reactions begins with the Hydroxyl OH radicals, which is one of the main chemical species controlling the oxidizing capacity of the global Earth atmosphere. They are produced by many pathways but most notably they are formed from the decomposition of hydro peroxides (ROOH) and by reaction of excited atomic oxygen with water.

The reaction involves the following steps:

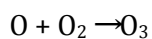
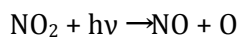
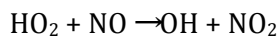
1. The Carbon Monoxide reacts with the Hydroxyl Radical, producing a Hydrogen atom.



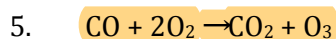
2. The hydrogen atom formed by this reacts rapidly with oxygen to give a peroxy radical HO₂



3. Peroxy radical then reacts with the NO and gives NO₂ which, in presence of Sunlight is photolysed to give atomic oxygen and through reaction with oxygen a molecule of ozone.



4. In total, the reaction is as follows:



The above reaction is simple one. The Chemical processes that involve the VOCs are the complex ones. But the result of these reactions is the Ozone.

Smog

Another most important secondary pollutant is the Smog, which has made up of Smoke and Fog. Traditionally, the smog has resulted from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Now-a-days, the Vehicle emissions and Industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

Problem of Persistent organic pollutants (POPs)

Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. They persist in the environment and are capable of long-range transport, bioaccumulation in human and animal tissue, biomagnified in food chains, and to have potential significant impacts on human health and the environment.

Deaths due to Air Pollution

✓ As per the WHO estimates, around 24 Lakh people in the world die due to direct impact of the air pollution. Out of which 15 Lakh people die due to Indoor pollution, due to the cardiopulmonary disease linked to breathing fine particle air pollution.

✓ The Air pollution has caused several short term disasters.

- ✓ In 1984, the Bhopal Disaster was caused on December 2-3, 1984, due to a leak of **methyl isocyanate gas** and other chemicals from the plant resulted in the exposure of hundreds of thousands of people. It killed more than 25,000 people outright and injured 150,000 to 600,000 people.
- ✓ Similarly in 1952, in UK, the **Great Smog of 1952** was formed over London on December 4. It was in the cold weather, combined with an anticyclone and windless conditions that the collected airborne pollutants mostly from the use of coal formed a form a thick layer of smog over the city. In six days more than 4,000 died, and 8,000 more died within the following months.
- ✓ In 1979, there was an accidental leak of anthrax spores from a biological warfare laboratory in the USSR near Sverdlovsk caused death of many people.

Top CO₂ emitting countries

The annual CO₂ emission worldwide is estimated to be around 29 billion metric tons. China with 6.5 billion metric tons annual emission of CO₂ is on top. The top 10 emitters are as follows:

Rank	Country	Annual CO ₂ emissions (in thousands of metric tonnes)	Percentage of global total
1	China	6,538,367.00	22.30%
2	United States	5,830,381.00	19.91%
-	European Union	4,177,817.86	14.04%
3	India	1,612,362.00	5.50%
4	Russia	1,537,357.00	5.24%
5	Japan	1,254,543.00	4.28%
6	Germany	787,936.00	2.69%
7	Canada	557,340.00	1.90%
8	United Kingdom	539,617.00	1.84%
9	South Korea	503,321.00	1.72%
10	Iran	495,987.00	1.69%

Highest Per Capita CO₂ emission

Qatar tops the list of the nations with Highest per capita CO₂ emission in the world. The following table shows the highest per capita CO₂ emission countries of the world.

Country	Emission
Qatar	56.2
United Arab Emirates	32.8
Kuwait	31.2
Bahrain	28.8
Trinidad and Tobago	25.3
Luxembourg	24.5
Netherlands Antilles	22.8
Aruba	22.3
United States	19
Australia	18.1
Source : USEIA, 2006	

Basics of Carbon Cycle

The flux of the Carbon Dioxide between the Oceans, terrestrial biosphere, lithosphere and atmosphere is called the Carbon Cycle. The Human activities have added to new flux of CO₂ in the atmosphere and out of which a part is absorbed by the plants while a part is taken by the Oceans. The Carbon Cycle is of two types viz. Organic and Inorganic carbon cycle. The Carbon Cycle as described for the first time by Joseph Priestley and Antoine Lavoisier is the interchange of CO₂ in the following:

- ✓ Atmosphere
- ✓ Terrestrial biosphere, including fresh water systems and soil carbon.
- ✓ The oceans, including dissolved inorganic carbon and living and non-living marine biota,
- ✓ The sediments including fossil fuels.
- ✓ The Earth's interior, carbon from the Earth's mantle and crust is released to the atmosphere and hydrosphere by volcanoes and geothermal systems.

Global Carbon Budget

The Global Carbon Budget Refers to the balance of the exchanges of carbon between the carbon reservoirs. This may refer to one specific pathway such as atmosphere to Biosphere or vice versa or many pathways. This is used to determine, whether a particular pool/ reservoir/ circle is working as a source of the Carbon dioxide or a sink of the Carbon Dioxide.

Ocean Acidification

Ocean acidification refers to the ongoing consistent decrease in the pH of the Ocean water. When CO₂ dissolved in the Ocean water, it creates Carbonic Acid (H₂CO₃) and increases the Hydrogen Ion (H⁺) concentration in the ocean.

- ✓ The Ocean acidification has fastened only after the Industrialization.
- ✗ Pre-Industrialization pH of the ocean water was 8.179.
- ✗ In the 20th century, it came down to 8.1074, which corresponds to an increase of H⁺ ions by 19%.
- ✗ **At present the pH of the Ocean water is 8.069** and this corresponds to an increase of 28.8% in the H⁺ Ions since Industrialization of the 18th century.

Impacts of Oceanic Acidification

- ✓ The absorption of the CO₂ by the world's Oceans helps in mitigating the climatic effects of Carbon Dioxide emissions. But the decrease in the pH will give negative impact to the oceanic organisms such as the Calcifying animals.
- ✓ The result will be seen in the Ocean ecosystem and food chains.
- ✓ The organisms such as corals, echinoderms, crustaceans and mollusks will be severely affected. This is because the falling pH makes the oceans under saturated with the CaCO₃, and the result is that rate of dissolution of calcareous material would increase.

The decreased pH may also lead to the hypercapnia in the ocean biota. Hypercapnia refers to the CO₂ induced acidification of body fluids, which may lead to adverse effects.

Acid Rains

✓ Acid rain refers to the precipitation with elevated levels of hydrogen ions or a low pH.

We all know that when fossil fuel is burnt, some of the elements within their molecules combine with oxygen and form oxides. The oxide produced in a large quantity is carbon dioxide, followed by smaller quantities of Sulfur Oxides and Nitrogen Oxides.

All of these oxides form the acidic solution when they dissolve in water.

✓ Out of these oxides, the Nitrogen oxides can also be produced naturally by lightning strikes.

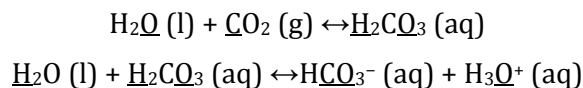
✓ Similarly, the Sulfur Dioxide can also be produced by the volcanic eruptions.

But these natural phenomena did not contribute the acidic rains compared to the anthropogenic activities.

The Acid Rains have been seen in many parts of the world more prominently since 1970s. In some parts of the world the Acid Rains with as low as 1.5pH has been witnessed.

Normal pH of Rainwater:

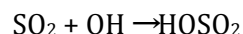
The pH of the pure water vapor in clouds is 7.0 but, even in unpolluted air, there is some carbon dioxide present, and this dissolves in rain drops to produce rain with ph of about 5.6 rains. So the rain is slightly acidic. This is shown by the following reactions:



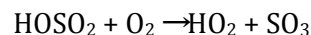
Chemistry of Acid Rains

✓ The **three kinds of Oxides matter in the Acid Rains**. They are Oxides of Sulphur, Oxides of Nitrogen and Oxides of Hydrogen viz. water and Hydroxyl Radicals.

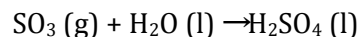
The sulphur dioxide is oxidized by reaction with the hydroxyl radical via an intermolecular reaction shown below:



HOSO₂ is unstable and it reacts with atmospheric Oxygen as follows:



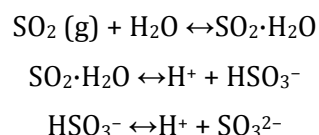
The Sulfur Trioxide SO₃ produced so quickly reacts with the water and forms the Sulphuric acid as follows:



The Nitrogen Dioxide also reacts with the OH to produce the Nitric Acid



The above reactions may take in the cloud drops as follows:



Impact on Biota and Human Life

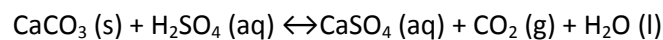
The Acid Rains show adverse **impact** on the **forests, freshwaters, soil and aquatic life forms**. The acid rain **eliminates the insect life** in the lakes and ponds. It **kills the soil organisms** and thus **changes the soil chemistry**.

Impact on Soil Chemistry:

In the soil, there is an adverse impact on the nutrients such as **Magnesium**. This is because, **Calcium and Magnesium are leached away by the Hydronium ion of the acids**.

Impact on Buildings:

Acid rain is capable of damaging the **buildings and historic monuments** which are made up of rocks such as limestone and marble. This is because these rocks contain a large amount of Calcium Carbonate, which reacts with the Sulfuric Acid to create Gypsum. Gypsum flakes off easily. This is shown in the following reaction:



Flue Gas Desulphurization (FGD)

This is one of the technical methods to control the emission of Sulfur Dioxide from the power plants that use Fossil Fuels. There are many strict environment regulations in force and this has led to development of many techniques. In these techniques the **SO2 is removed from flue gases** many methods such as **wet scrubbing** using a **slurry limestone**. Using the **Wet Sulphuric Acid Process**, the SO2 is processed to create the Sulphuric acid of industrial quality.

Convention on Long-Range Transboundary Air Pollution (CLRTAP)

- ✓ CLRTAP is an international convention on controlling the Air Pollution. The convention came into being in March **1983** and has 51 parties.
- ✓ Since its adoption in 1979, CLRTAP has addressed some of the major environmental problems of the **UNECE region** (United Nations Economic Commission for Europe). This has been achieved through a process of **scientific collaboration and policy negotiation**.
- ✓ In this way, since its entry into force in 1983, the **Convention** has been **extended by eight protocols** which identify specific obligations or measures to be taken by Parties. The major protocols are **Sulphur Emissions Reduction Protocol** and **Gothenburg protocol**.

Sulphur Emissions Reduction Protocol

Sulphur Emissions Reduction Protocol is a protocol that aims at reducing the emission of Sulphur by at least 30%. It came into force in 1987 and had 22 parties. It was succeeded by another protocol in 1998 which aims to further reduce the Sulphur emissions. The new protocol has 23 parties. **India is not** a party.

Gothenburg protocol

A Protocol to Abate Acidification, Eutrophication and Ground-level Ozone was adopted by the countries of UNECE in Gothenburg (Sweden) on 30 November 1999.

- ✓ This protocol is also known as **Muti-effect protocol**.
- ✓ The Protocol sets emission **ceilings for 2010** for four pollutants: **Sulphur, NOx, VOCs and ammonia**.

- ✓ These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options.
- ✓ Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce will have to make the biggest cuts. It was predicted that the implementation of the Protocol in Europe will reduce sulphur emissions there by at least 63%, NO_x emissions by 41%, VOC emissions by 40% and ammonia emissions by 17% compared to levels in 1990. Currently, the protocol is under negotiation for a revised protocol.

Acid Rain Program

Acid Rain Program came into being after the 1990 Clean Air Act, which is a United States federal law enacted by the United States Congress to control air pollution on a national level, came into being. The Acid Rain Programme is being carried out by the United States Environmental Protection Agency, with an objective to reduce overall atmospheric levels of sulfur dioxide and nitrogen oxides, which cause acid rain in US. This programme implements the Emission Trading and targets the Coal Burning Power Plants. By Emission Trading, the programme allows the power plants whereby, each ton of sulfur dioxide emitted, is subject to a mandatory fine of \$2,000.00 for each ton emitted in excess of allowances held.

Greenhouse Gases (GHGs)

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect.

- ✓ Water vapour (H₂O), carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and ozone (O₃) are the primary greenhouse gases in the Earth's atmosphere.
- ✓ Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol.
- ✓ Beside CO₂, N₂O and CH₄, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF₆), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

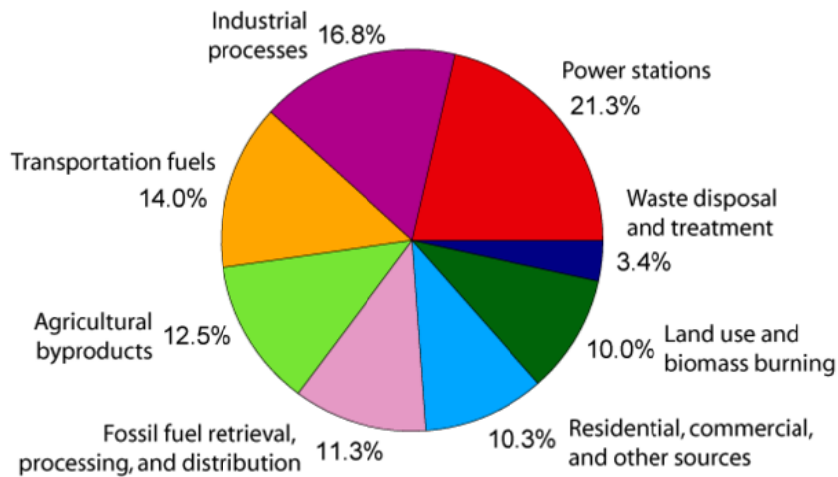
Forcing GHGs

The most dominant greenhouse gas overall is water vapour, but it has a very short atmospheric lifetime (about 10 days) and is very nearly in a dynamic equilibrium in the atmosphere, so it is not a forcing gas in the context of global warming.

Scientists have identified carbon dioxide as the dominant greenhouse gas forcing. Methane and nitrous oxide are also major forcing contributors to the greenhouse effect.

GHG by sectors

Maximum anthropogenic GHG emission is by Power Stations (over 21%) as shown in the following chart. It is followed by the Industrial Processes (around 17%).



Green House Effect

In the Green House Effect, the thermal radiation from a planetary surface is **absorbed** by atmospheric greenhouse gases, and is **re-radiated** in all directions. The result is that the temperature is higher than it would be if direct heating by solar radiation were the only warming mechanism.

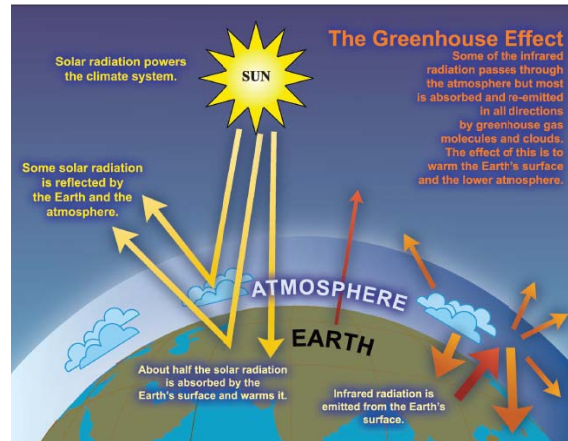
- ✓ Names of three scientists are associated with the Green House Effect.
- ✓ Joseph Fourier discovered it in 1824. John Tyndall in 1858 carried out some reliable experiments and Svante Arrhenius in 1896 reported quantitatively on the impacts.

Process:

We all know that Earth receives the energy from Sun in the form of **Ultraviolet, Visible** and **Near Infra** Red radiation. Except most of the UV radiation, almost all of them pass through the atmosphere without being absorbed. Out of this 50% is absorbed by the surface of the Earth. When it becomes warm, its surface radiates the far Infrared thermal radiation, which has **longer** wavelengths than that of the radiation absorbed. This thermal radiation is absorbed by the atmosphere, and the atmosphere reradiates it both upwards and downwards. The radiation that is sent downward again raises the temperature of the Earth.

- ✓ Thus the **long wave radiation is trapped** and the equilibrium temperature of earth is higher than if there was no atmosphere. This is known as Green House Effect.
- ✓ The Incoming sun light is mostly in the form of visible light and nearby wavelengths, in the range 0.2–4 μm.
- ✓ Out of this **half is visible light**.
- ✓ The loss of the Radiation is almost nothing at the surface level but maximum at higher in the atmosphere because of the decreasing concentration of water vapor, an important greenhouse gas.
- ✓ While the major atmospheric components (**Nitrogen and Oxygen**) **absorb** little or **no radiation**, some of the minor components are effective absorbers.
- ✓ Particularly effective is water vapor and CO₂ which absorb effectively in the IR wavelength range.
- ✓ These absorbing gases and their surrounding air warm up, emitting radiation downward, towards the Earth's surface, as well as upward, towards space.

- ✓ This effectively traps part of the IR radiation between ground and the **lower 10 km** of the atmosphere. This reduction in the efficiency of the Earth to lose heat causes the surface temperature to rise above the effective temperature until finally, enough heat is able to escape to space to balance the incoming solar radiation.
- ✓ The effect is analogous to that of a blanket that traps the body heat preventing it from escaping into the room and thus keeps us warm on cold nights.



Important Points

- ✍ If Earth was an **ideal black body** which absorbs all the radiation from the Sun and emit the radiation due to this heating, its temperature would have been **5.3 °C**.
- ✍ The Earth and other planets are not perfect black bodies, as they do not absorb all the incoming solar radiation but reflected part of it back to space.
- ✍ The ratio between the reflected and the incoming energies is termed the planetary **albedo**.
- ✍ Earth reflects 36-37% of this incoming light and it corresponds to the Earth Albedo 0.367.
- ✍ So, Earth's mean temperature is 14 °C. If there were no atmosphere and no radiation was lost due to reflection, its mean temperature would have been -18 or -19 °C. This difference is due to the Green House Effect.

Anti-greenhouse effect

Many planetary bodies show the Green House Effect.

- ✓ In our solar System, **Mars and Venus** show the Green House Effect, but **Titan, the largest planet of Saturn and Pluto, shows the opposite phenomena** which is called Anti-Green House Effect.

Greenhouse effect occurs because the atmosphere transparent to solar radiation, but largely opaque to infrared and far infrared emitted by the planet / body.

But in anti-greenhouse effect, the atmosphere is opaque to solar but lets out infrared.

The effect is that the body is cooler than the actual temperature would have been. In case of Titan, both Green House Effect and Anti Green House Effect have been proved. Due to Green House Effect, the temperature goes up by 21K while, due to Anti-Green House effect, the temperature goes down by 9K. The result is that surface temperature is 12 K warmer than without atmosphere.

- ✓ At Pluto, there is different mechanism. Here, the sunlight causes the Nitrogen ice to sublime which cools the body.

Basics of Climate Change

Climate

- ✓ Climate is often defined as 'average weather'. Climate is usually described in terms of the mean and variability of temperature, precipitation and wind over a period of time, ranging from months to millions of years (the classical period is 30 years).

Forcing

- ✓ The climate system evolves in time under the influence of its own internal dynamics and due to changes in external factors that affect climate (called 'forcings').
- ✓ External forcings include natural phenomena such as volcanic eruptions and solar variations, as well as human-induced changes in atmospheric composition. Solar radiation powers the climate system.

Radiation Balance

- ✓ There are three fundamental ways to change the radiation balance of the Earth:
 - by changing the incoming solar radiation (e.g., by changes in Earth's orbit or in the Sun itself)
 - by changing the fraction of solar radiation that is reflected (called 'albedo'; e.g., by changes in cloud cover, atmospheric particles or vegetation)
 - by altering the long wave radiation from Earth back towards space (e.g., by changing greenhouse gas concentrations).
- ✓ The Climate, in turn, responds directly to such changes, as well as indirectly, through a variety of feedback mechanisms.
- ✓ The amount of energy reaching the top of Earth's atmosphere each second on a surface area of one square meter facing the Sun during daytime is about 1,370 Watts, and the amount of energy per square metre per second averaged over the entire planet is one-quarter of this
- ✓ About 30% of the sunlight that reaches the top of the atmosphere is reflected back to space. Roughly two-thirds of this reflectivity is due to clouds and small particles in the atmosphere known as 'aerosols'.
- ✓ Light-coloured areas of Earth's surface – mainly snow, ice and deserts – reflect the remaining one-third of the sunlight.


Volcanic Eruptions

- ✓ The most dramatic change in aerosol-produced reflectivity comes when major volcanic eruptions eject material very high into the atmosphere.
- ✓ Rain typically clears aerosols out of the atmosphere in a week or two, but when material from a violent volcanic eruption is projected far above the highest cloud, these aerosols typically influence

the climate for about a year or two before falling into the troposphere and being carried to the surface by precipitation.

- ✓ Major volcanic eruptions can thus cause a drop in mean global surface temperature of about half a degree Celsius that can last for months or even years.

Long Wave emissions

- ✓ Some man-made aerosols also significantly reflect sunlight. The energy that is not reflected back to space is absorbed by the Earth's surface and atmosphere.
- ✓ This amount is approximately 240 Watts per square metre ($W m^2$). To balance the incoming energy, the Earth itself must radiate, on average, the same amount of energy back to space. The Earth does this by emitting outgoing longwave radiation. Everything on Earth emits long wave radiation continuously. 
- ✓ That is the heat energy one feels radiating out from a fire; the warmer an object, the more heat energy it radiates. To emit $240 W m^2$, a surface would have to have a temperature of around $-19^\circ C$. This is much colder than the conditions that actually exist at the Earth's surface (the global mean surface temperature is about $14^\circ C$). Instead, the necessary $-19^\circ C$ is found at an altitude about 5 km above the surface.

Natural Green House Effect:

- ✓ The reason the Earth's surface is this warm is the presence of greenhouse gases, which act as a partial blanket for the long wave radiation coming from the surface. This blanketing is known as the natural greenhouse effect.
- ✓ The most important greenhouse gases are water vapor and carbon dioxide. The two most abundant constituents of the atmosphere – nitrogen and oxygen – have no such effect.
- ✓ Clouds, on the other hand, do exert a blanketing effect similar to that of the greenhouse gases; however, this effect is offset by their reflectivity, such that on average, clouds tend to have a cooling effect on climate (although locally one can feel the warming effect: cloudy nights tend to remain warmer than clear nights because the clouds radiate long wave energy back down to the surface).

Human Activities

- ✓ Human activities intensify the blanketing effect through the release of greenhouse gases. For instance, the amount of carbon dioxide in the atmosphere has increased by about 35% in the industrial era, and this increase is known to be due to human activities, primarily the combustion of fossil fuels and removal of forests.
- ✓ Thus, humankind has dramatically altered the chemical composition of the global atmosphere with substantial implications for climate.

Transportation of Energy: Atmospheric circulation

- ✓ Because the Earth is a sphere, more solar energy arrives for a given surface area in the tropics than at higher latitudes, where sunlight strikes the atmosphere at a lower angle. Energy is transported from the equatorial areas to higher latitudes via atmospheric and oceanic circulations, including

storm systems. Energy is also required to evaporate water from the sea or land surface, and this energy, called **latent heat**, is released when water vapor condenses in clouds.

- ✓ **Atmospheric circulation is primarily driven by the release of this latent heat.** Atmospheric circulation in turn drives much of the ocean circulation through the action of winds on the surface waters of the ocean, and through changes in the ocean's surface temperature and salinity through precipitation and evaporation.

Rotation of Earth

- ✓ Due to the rotation of the Earth, the atmospheric circulation patterns tend to be **more east-west** than north-south. Embedded in the mid-latitude **westerly winds are large-scale weather systems** that act to transport heat toward the poles.
- ✓ These weather systems are the familiar migrating low- and high-pressure systems and their associated cold and warm fronts.

Feedback mechanisms

- ✓ There are many feedback mechanisms in the climate system that can either **amplify** ('positive feedback') or **diminish** ('negative feedback') the effects of a change in climate forcing. For example, as rising concentrations of greenhouse gases warm Earth's climate, snow and ice begin to melt. This melting reveals darker land and water surfaces that were beneath the snow and ice, and these darker surfaces absorb more of the Sun's heat, causing more warming, which causes more melting, and so on, in a self reinforcing cycle.

Ice-albedo feedback

- ✓ This feedback loop, known as the **'ice-albedo feedback'**, amplifies the initial warming caused by rising levels of greenhouse gases. Detecting, understanding and accurately quantifying climate feedbacks have been the focus of a great deal of research by scientists unravelling the complexities of Earth's climate.

How Climate can be predicted but Weather can not?

Climate is defined as average weather, and as such, climate change and weather are intertwined. Observations can show that there have been changes in weather, and it is the statistics of changes in weather over time that identifies climate change.

While weather and climate are closely related, there are important differences. A common confusion between weather and climate arises when scientists are asked how they can predict climate 50 years from now when they cannot predict the weather a few weeks from now.

- ✓ The chaotic nature of weather makes it unpredictable beyond a few days. Projecting changes in climate (i.e., long-term average weather) due to changes in atmospheric composition or other factors is a very different and much more manageable issue.

As an analogy, while it is impossible to predict the age at which any particular man will die, we can say with high confidence that the average age of death for men in industrialized countries is about 75. Another

common confusion of these issues is thinking that a cold winter or a cooling spot on the globe is evidence against global warming.

Climate Feedback and Polar amplification

Climate models generally predict amplified warming in polar regions due to climate feedbacks. This is called **Polar amplification**. This can be understood by the fact that due to the climate changes, the Arctic has warmed much leading to Arctic Shrinkage. Most simple climate models predict warming at both poles but please note that the **Antarctic has not warmed as much as the Arctic**.

- ✓ **It is the Polar amplification that has led to the Arctic shrinkage.**
- ✓ **Arctic Shrinkage** refers to the **decrease in size of the Arctic region** and is agreed to be a result of global warming. As per the projections, Arctic may be free of the summer ice at anytime between 2060 and 2080. This is the reason **that Arctic is often seen as a high-sensitivity indicator of climate change**.

Carbon Footprint

'Carbon Footprint' measures the **total greenhouse gas emissions** caused **directly and indirectly by a person, organization, event or product**.

- ✓ The **Kyoto Protocol recognizes 6 GHGs** and Carbon footprint considers all **six of the Kyoto Protocol** greenhouse gases viz. Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF₆).

Measurement of Carbon Foot Print:

A carbon footprint is measured in **tons of carbon dioxide equivalent (tCO₂e)**. The carbon dioxide equivalent (CO₂e) allows the **different greenhouse gases to be compared** on a like-for-like basis relative to one unit of CO₂. CO₂e is calculated by multiplying the emissions of each of the six greenhouse gases by its 100 year global warming potential (GWP).

Types of Carbon foot Print:

Two types of carbon foot printing. The main types of carbon footprint are:

1. Organizational

Emissions from all the activities across the organisation, including buildings' energy use, industrial processes and company vehicles.

2. Product

Emissions over the whole life of a product or service, from the extraction of raw materials and manufacturing right through to its use and final reuse, recycling or disposal.

Carbon Offsetting

Mitigation of carbon footprints through the **development of alternative projects** is known as **Carbon offsetting**. The alternative projects may be the solar, wind, Tidal energy or reforestation.

Carbon sequestration

Carbon Offsetting is different from the Carbon sequestration, which **refers to the "process of removing carbon from the atmosphere and depositing it in a reservoir**. It's a part of the Geoengineering and refers to

the process of carbon capture and storage, where CO₂ is removed from flue gases, on power stations etc., before being stored in underground reservoirs.

Oxygen Minimum Zone (OMZ)

Oxygen minimum zone (OMZ) , also known as shadow zone is the zone in Oceans where the oxygen saturation is at its lowest. This refers to depths of about 200 to 1,000 meters, depending on local circumstances.

✍ The expansion of the OMZ as a consequence to anthropogenic emissions of CO₂ is called Ocean deoxygenation.

Dead Zones

The Low oxygen areas in the world's oceans or large lakes where no aquatic life is supported are known as Dead Zones. So, the Dead Zones are formed due to low Oxygen or Hypoxia. As per the first Global Environment Outlook Year Book (2003), there are 146 dead zones in the world's oceans where marine life could not be supported due to depleted oxygen levels. In 2008, the number rose to 405.

✍ Currently the most notorious dead zone is a 22,126 square kilometre region in the Gulf of Mexico.

Global dimming

The gradual reduction in the amount of global direct irradiance at the Earth's surface is called Global dimming. It is believed that it has been caused by the increase in particulates such as sulfate aerosols in the atmosphere due to human action.

✍ In 1990s, there was a trend from Global dimming to Global brightening , when the emission of the above particles got reduced.

Eutrophication

In context with environment, the Eutrophication refers to the addition of artificial or non-artificial substances, such as nitrates and phosphates, through fertilizers or sewage, to a fresh water system. It can be anthropogenic or natural. It leads increase in the primary productivity of the water body or "bloom" of phytoplankton. The overgrowth causes the loss of oxygen in the water leading to severe reductions in fish and other animal populations.

✍ However, the Nomurai Jellyfish is an exception which shows an increase in population that negatively affects other species in the local ecosystem.

Air Quality Index (AQI) & SAFAR

Air Quality Index (AQI) or Air Pollution Index (API) or Pollutant Standard Index (PSI) is an index used by governments / Government agencies to characterize the quality of the air at a given location using the concentration of one or more pollutants as measure of severity of pollution. It's a public information tool that helps protect public health on a daily basis from the negative effects of air pollution. The Air Quality Index is a scale designed to help public understand what the air quality around them means to their health. In addition, Emission inventory or criteria pollutants are an important component of the forecasting model.

✍ In India, in the latter half of 2010, the "System of Air Quality Forecasting and Research (SAFAR) was dedicated to the nation at the Jawaharlal Nehru Stadium on the occasion of CWG New Delhi 2010. This system has been developed indigenously.

It encompasses 11 Air Quality Monitoring Stations, 34 Automatic weather stations in NCR along with GPS observations and Doppler Weather radar.

✍ This is for the first time that India had a system for air quality forecasting and New Delhi became the first city in the country to be able to provide, 24 hour advance forecast for criteria pollutants namely Ozone, Oxides of Nitrogen, Carbon Monoxide, Particulate Matters <2.5µm (PM2.5), Particulate Matters < 10µm (PM10), Benzene, Toluene, Xylene, and Black carbon.

✍ SAFAR system for the air quality has been developed by the Indian institute of Tropical Meteorology (IITM), Pune and weather information and forecasting is done by India Meteorological Department (IMD).

Emission Standards : BS III

✍ First Indian emission regulations were idle emission limits which became effective in 1989.

✍ In 1991, Idle CO2 Limits for Gasoline Vehicles and Free Acceleration Smoke for Diesel Vehicles, Mass Emission Norms for Gasoline Vehicles were issued. In the next year, Mass Emission Norms for Diesel Vehicles were formulated in India, which were revised in 1996.

✍ In 1998 Cold Start Norms were introduced in India.

✍ In 2000, India 2000 (Eq. to Euro I) Norms, Modified IDC (Indian Driving Cycle), Bharat Stage II Norms were introduced for Delhi.

Since 2000, India has started adopting European emission and fuel regulations for four-wheeled light-duty and for heavy-dc. Indian own emission regulations still apply to two- and three-wheeled vehicles.

The following table shows the reference of BS with Euro standards.

Standard	Reference	Date	Region
India 2000	Euro 1	2000	Nationwide
Bharat Stage II	Euro 2	2001	NCR, Mumbai, Kolkata, Chennai
		2003.04	NCR, 12 Cities
		2005.04	Nationwide
Bharat Stage III	Euro 3	2005.04	NCR, 12 Cities
		2010.04	Nationwide
Bharat Stage IV	Euro 4	2010.04	NCR, 12 Cities

As the table above shows, the implementation of BS-III was earlier scheduled for April 2010. However, in May the government extended the implementation till October 2010. Now, the Oil Industry has completed the implementation of **BS-III Petrol and Diesel in the entire country**. Introduction of BS-III Petrol was advanced in 20 states and BS-III Diesel in 23 States. In the last leg, BS-III Petrol and Diesel has been introduced in the seven North Eastern States in September 2010. Oil Industry had already introduced **BS-IV Petrol and Diesel in all 13 identified cities** (NCR of Delhi, Agra, Kanpur, Lucknow, Kolkata, Mumbai, Ahmedabad, Surat, Pune, Solapur, Chennai, Bangalore and Hyderabad) on April 1, 2010.

Emissions Trading

It is also known as **Cap & Trade**. In this, the **central authority sets a limit of cap** on the **amount of a pollutant that can be emitted**. This limit is sold to the firms in the form of emission permits. An emission permit represents the right to emit the specific volume of a particular pollutant. The Firm would need to hold the number of permits equivalent to their emissions. The number of **these permits can not exceed a cap**. If a firm wants to increase the emission permits, it would buy from those who need fewer permits. This **transfer of permits is called Emission Trade**.

- ✓ Thus the centrelines is that: *The buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions.*

Currently there are two main active trading programmes.

1. For greenhouse gases the **European Union Emission Trading Scheme** is the **largest** programme.
2. **National Market** to reduce acid rain in **United States**.

The emission trading schemes have **great potential to lower the pollution** while minimizing the costs for industries. On the industry side, units are able to choose for themselves the cheapest way to reduce pollution.

✍ These programmes are better compared to the traditional command- and-control regulations. The **command- and-control regulations** do not allow for differences across industries and mandate the same standard everywhere. This generally misses the best opportunities for abatement.

Emission Trading System also provide a **self- regulating system** that makes pollution control more efficient. In the longer run, the reduced costs of compliance can also make it easier to introduce new regulations that increase environmental quality.

Components of emission trading

The Components of the emission trading are as follows:

1. **Setting the Cap**- The target for aggregate emissions from the sector where trading is introduced must be set to produce reasonable prices and emissions reductions.
2. **Allocating Permits** -The permits to emit must be distributed in an equitable way to build support for the scheme. In many successful cases this allocation has been made for free relative to baseline emissions, greatly reducing the cost of compliance for industries.
3. **Monitoring** - The quantity of emissions from each industrial plant must be reliably and continuously monitored with high integrity recognized by all sides.
4. **Compliance** - The regulatory framework must make industries confident that buying permits is the only reliable way to meet environmental obligations.

In India

- ✍ India is in the **process of introduction** of emission trading.
- ✍ The first domestic emissions trading scheme has begun in Tamil Nadu and Gujarat from February 2011.

Introduction of emissions trading would position India as a clear leader in environmental regulation amongst emerging economies. The benefits of a trading scheme will extend beyond the immediate goal of achieving compliance at a lower cost to society. Having a trading scheme in place will make it easier to adjust regulation as environmental goals change. **Tighter environmental standards can be achieved with a drop in the level of the cap, which would raise the price of emissions permits and give incentives to pollute less,** rather than abruptly throwing certain areas or sources out of compliance.

Aarhus Convention

Formal name of the Aarhus Convention is **UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters**. It was signed in 1998 in the Danish city of Aarhus and entered into **force in 2001**. It is ratified by 41 countries which include the EU members and Central Asian Countries.

✍ The most notable feature enshrined in EU legislations based upon this treaty is **Water Framework Directive**.

Aarhus Convention **grants the public rights** regarding **access to information, public participation** and access to **justice**, in governmental decision-making processes **on matters concerning** the local, national and Transboundary **environment**.

Espoo Convention

The formal name of **Espoo Convention** is "*Convention on Environmental Impact Assessment in a Transboundary Context*". It is a convention on Environmental Impact Assessment in a Transboundary Context is a **United Nations Economic Commission for Europe (UNECE)**. It entered into force in 1997. The parties are bound to carry out an environmental impact assessment of certain activities at an early stage of planning.

Earth Summit 1992

Earth Summit 1992 was the **United Nations Conference on Environment and Development (UNCED)**, commonly known as the Rio Summit, Rio Conference. It was a major United Nations conference held in Rio de Janeiro from 3 June to 14 June 1992. It was attended by 172 Governments. The outcome of this summit was the following documents:

- 1. Rio Declaration on Environment and Development**
- 2. Agenda 21**
- 3. Convention on Biological Diversity**
- 4. Forest Principles**
- 5. Framework Convention on Climate Change (UNFCCC).**

✍ Out of the above, the documents on **Convention on Biological Diversity and UNFCCC** were set as **legally binding agreements**.

Foundation of Green Cross International

Following the Earth Summit 1992, **Green Cross International** was founded by former Soviet leader **Mikhail Gorbachev in 1993** to help ensure a **just, sustainable and secure future** for all by fostering a value shift and

cultivating a new sense of global interdependence and **shared responsibility in humanity's relationship with nature**. After that, Thirty-one countries have established Green Cross National organisations which are part of Green Cross International.

Rio Declaration on Environment and Development

Rio Declaration on Environment and Development consisted of **27 principles** intended to **guide future sustainable development around the world**.

1. The role of humans.
2. State sovereignty
3. The Right to development
4. Environmental Protection in the Development Process
5. Eradication of Poverty
6. Priority for the Least Developed
7. State Cooperation to Protect Ecosystem
8. Reduction of Unsustainable Patterns of Production and Consumption
9. Capacity Building for Sustainable Development
10. Public participation
11. National Environmental Legislation
12. Supportive and Open International Economic System
13. Compensation for Victims of Pollution and other Environmental Damage
14. State Cooperation to Prevent environmental dumping
15. Precautionary principle
16. Internalization of Environmental Costs
17. Environmental Impact Assessments
18. Notification of Natural Disaster
19. Prior and Timely Notification
20. Women have a Vital Role
21. Youth Mobilization
22. Indigenous Peoples have a Vital Role
23. People under Oppression
24. Warfare
25. Peace, Development and Environmental Protection
26. Resolution of Environmental Disputes
27. Cooperation between State and People

✍ Some Scholars have regarded the Rio Declaration as **Third Generation Human Rights**.

Agenda 21

Agenda 21 is yet another outcome of the 1992 Earth Summit. It is the **"Voluntary" action plan** of the United Nations (UN) related to **sustainable development**. This 40 point document was a comprehensive blueprint of **action to be taken globally, nationally and locally** by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment.

For implementation of these points a **Commission on Sustainable Development** was established as a high level forum on sustainable development. The United Nations Division for Sustainable Development acts as the secretariat to the Commission and works 'within the context of' Agenda 21.

✍ **Rio+5** : The Rio+5 was the special session of the UN General Assembly organized in 1997 for appraisal of five years of progress on the implementation of Agenda 21.

✍ **LA21** : Local programmes as per recommended in Agenda 21 are known as 'Local Agenda 21' or 'LA21'.

Convention on Biological Diversity

Convention on Biological Diversity is a **legally binding document**, which came as an outcome of Earth Summit in Rio de Janeiro on 5 June 1992 and **entered into force** on 29 December **1993**. It is commonly known as "Biodiversity Convention".

Objectives:

1. Conservation of biological diversity (or biodiversity);
2. **Sustainable** use of its components; and
3. Fair and equitable sharing of benefits arising from **genetic resources**



The idea is to develop national strategies for the conservation and sustainable use of biological diversity.

Parties:

✍ 198 countries / territories **including India** are parties to the CBD.

✍ The **United States** has signed but **not ratified** the convention.

CBD – Important Provisions

The CBD has 23 preamble paragraphs and 42 articles. The **preamble paragraphs** inter alia recognize and reaffirm the following:

- a. Intrinsic value of biodiversity
- b. Biodiversity conservation as common concern of humankind
- c. **Sovereign rights of States** over their biological resources
- d. Responsibility of States to conserve and sustainable use their biodiversity
- e. Precautionary approach towards biodiversity conservation
- f. Vital role of local **communities** and **women** in conservation, and sustainable use of biodiversity
- g. Need for provision of new and additional **financial resources** and **access to technologies** to **developing** countries to address biodiversity loss.

Economic and social development and poverty eradication are the first and overriding priorities of developing countries.

Why US not ratified the CBD?

By 2009, US, Iraq, Somalia and Andorra had to sign and ratify the CBD. With Iraq's accession to the CBD in July 2009, the US, Somalia and Andorra are now the only remaining countries that have not signed / ratified the CBD.

- ✓ US has ratified the UNFCCC and UNCCD (United Nations Convention to Combat Desertification), but did not ratify the CBD.

- ✓ Please note that the main concerns of United States are the CBD provisions, **which call for technology transfer to developing countries**. US thinks that **it could threaten US intellectual property interests**.
- ✓ Further, there is another reason that the **obligations for financial aid** under the CBD are vague. Strangely, the other developed countries have not shared these concerns.

Cartagena Protocol on Biosafety

On 29 January **2000**, the Conference of the Parties to the Convention on Biological Diversity adopted a **supplementary agreement** to the Convention known as the Cartagena Protocol on Biosafety. The Protocol seeks to **protect biological diversity** from the potential risks posed by **living modified organisms** resulting from modern biotechnology.

Advance Informed Agreement (AIA) procedure

The Cartagena Protocol on Biosafety establishes an advance informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. The Protocol contains reference to a precautionary approach and reaffirms the **precaution language** in Principle 15 of the Rio Declaration on Environment and Development. The Protocol also establishes a **Biosafety Clearing-House** to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of the Protocol.

Conference of the Parties (COP):


The **Governing body of the CBD** is the Conference of the Parties (COP), which **consists** of **all governments** (and regional economic integration organizations) that have ratified the treaty. This ultimate authority reviews progress under the Convention, identifies new priorities, and sets work plans for members. The **COP** can also **make amendments** to the Convention, create expert advisory bodies, review progress reports by member nations, and collaborate with other international organizations and agreements.

✍ Till now 10 COP have held.

2010 International Year of Biodiversity

The United Nations declared 2010 the International Year of Biodiversity (IYB) to raise awareness about the crucial importance of biodiversity, to communicate the human costs of biodiversity loss, and to engage people, particularly youth, throughout the world in the fight to protect all life on Earth. Initiatives will be organized throughout the year to disseminate information, promote the protection of biodiversity and encourage countries, organizations, and individuals to take direct action to reduce biodiversity loss. The focal point for the year is the Secretariat of the Convention on Biological Diversity.

Latest COP - COP 10

10th Conference of Parties to the Convention on Biological Diversity was held in October in Nagoya Japan, the **Nagoya Protocol** was adopted. 

Nagoya Protocol

On 29 October 2010, some 18,000 participants representing the 193 Parties to the Convention on Biological Diversity (CBD) and their partners closed the Nagoya Biodiversity Summit by adopting historic decisions that will permit the community of nations to meet the unprecedented challenges of the continued loss of biodiversity compounded by climate change.

The Governments agreed on a package of measures that will ensure that the ecosystems of the planet will continue to sustain human well-being into the future.

Goals of Nagoya Protocol:

The meeting achieved its three inter-linked goals:

- ✓ Adoption of a new ten year Strategic Plan to guide international and national efforts to save biodiversity through enhanced action to meet the objectives of the Convention on Biological Diversity
- ✓ A resource mobilization strategy that provides the way forward to a substantial increase to current levels of official development assistance in support of biodiversity
- ✓ A new international protocol on access to and sharing of the benefits from the use of the genetic resources of the planet.

Notable Statement

"If Kyoto entered history as the city where the climate accord was born, Nagoya will be remembered as the city where the biodiversity accord was born."

Notable Point:

✍ United States is NOT among the nearly 200 signatories of the Access and Benefit Sharing rules of the Nagoya Protocol. Getting the Americans into the net will be a key aim of the next U.N. summit on biodiversity to be held in New Delhi in 2012.

Nagoya's Outcome: Aichi Target



The strategic plan which is outcome of the Nagoya Protocol is "Aichi Target". It includes 20 headline targets, organized under five strategic goals that address the underlying causes of biodiversity loss, reduce the pressures on biodiversity, safeguard biodiversity at all levels, enhance the benefits provided by biodiversity, and provide for capacity-building.

The important agreements were as follows:

1. At least halve and where feasible bring close to zero the rate of loss of natural habitats including forests
2. Established a target of 17 per cent of terrestrial and inland water areas and 10 per cent of marine and coastal areas
3. Through conservation and restoration, Governments will restore at least 15 percent of degraded areas
4. Will make special efforts to reduce the pressures faced by coral reefs.
5. Parties also agreed to a substantial increase in the level of financial resources in support of implementation of the Convention.

The Nagoya Access and Benefit Sharing Protocol

✍ **This is called the new ABS Rules.**

On the last day of the convention, the International Regime on Access and Benefit Sharing of Genetic Resources (ABS) came out.

- ✍ The treaty is a Protocol to the main convention, and lays down basic ground rules on how nations cooperate in obtaining genetic resources from animals to plants and fungi.
- ✍ Please note that countries **could not reach to a legally binding protocol**, yet it outlines how the benefits, arising for example when a plant's genetics are turned into a commercial product such as a pharmaceutical, are shared with the countries and communities who have conserved and managed that resource often for millennia.

Important Points

- ✍ The new Nagoya Protocol on ABS lays out rules on how **derivatives**-substances and compounds derived from genetic resources- **will be dealt** with under an ABS regime.
- ✍ It addresses the issue of **traditional knowledge and pathogens**-for example how developed countries may in emergency situations obtain a flu virus in order to develop a vaccine to counter a possible epidemic.
- ✍ It says governments should begin considering ways of **recompensing developing countries** for genetic material that may have been collected years, decades even centuries ago- if in future they become used to produce say a new pharmaceutical or crop variety.

Complete Details are available here:

<http://www.cbd.int/doc/press/2010/pr-2010-10-29-cop-10-en.pdf>

Copy of ABS is located here

<http://ictsd.org/downloads/2010/11/abs-protocol.pdf>

India and Nagoya Protocol:

For India and other developing countries, it was a hard-fought triumph because **this new international treaty ensures that the benefits of natural resources and their commercial derivatives were shared with local communities.**

- ✍ India is incoming president of the next summit and the protocol matters a lot as both **derivatives** and **pathogens** are part of the ABS.

Points that Matter

- ✍ The new the Access and Benefit Sharing (ABS) rules mean that **multinational companies will have to share their profits with local communities not only for using the original resource, but also any derivative products developed from it.**

- ✍ The ABS is the result of almost two decades of U.N. negotiations, where India leads a group of **17 mega diverse countries with rich reserves of exploitable natural resources.**

- ✍ International drug firms will also have to pay to use human genetic material such as pathogens – the germs responsible for virus pandemics which are used to develop lucrative vaccines. “Otherwise, these companies just take our pathogens, make the vaccine, and then make us pay billions of dollars to buy it from them.

India's Agenda for 2012:

In order to bring the American companies into the ramifications of this agreement, **the U.N.'s Convention on Biological Diversity must be linked to the World Trade Organisation's intellectual property agreement.** "the TRIPS (Trade Related Aspects of Intellectual Property Rights) must be amended to bring the U.S. into the mainstream. That is my single point agenda...to wrap up before Delhi 2012 - Jai Ram Ramesh, then Environment Minister of India.

Natural Capital:

The countries at Nagoya also agreed to **bring "natural capital" into national accounting systems** so that the trillions of dollars worth of benefits that nature provides to economies are valued. India will take the lead by undertaking a national study on The Economics of Ecosystems and Biodiversity soon.

Access Benefit Sharing & India's Standpoint

The article 1 of the CBD sets out:

fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources to technologies, and by appropriate funding.

Similarly, Article 8(j) of the convention contains provision to:

"encourage the equitable sharing of the benefits arising from utilization of knowledge, innovations and practices of indigenous and local community embodying traditional lifestyles relevant for conservation and sustainable use of biological diversity".

Thus, **access to the genetic resources and sharing of benefits arising out of the use of these resources makes the core of the CBD.** But in the operationalising the benefit sharing provisions of the CBD are hindered with many complexities. Not much progress has been made in implementation of the core objectives of the CBD.

What is the major issue?

✍ The CBD envisages the provisions that access to genetic resources and realization of benefits is subject to **national legislation** through formalization of **prior informed consent (PIC)** and **mutually agreed terms (MAT)**. India has its own concerns about this.

What does India say?


- ✍ India has been a victim of Bio-piracy. India says that national action alone is not sufficient to ensure realization of benefits to the country of origin or provider country.
- ✍ In many cases, the genetic material is sourced from one country is utilized in another country for developing products and processes on which patent protection is obtained. So, the source country does not get any shares in the benefit.
- ✍ India says that the onus of benefit sharing must also be shared by the user country to create an enabling environment and confidence through legislative measures can be build up.

What is the suggestion by India?

To ensure that the onus of benefit sharing must also be **shared by the user country** to create an enabling environment and confidence through legislative measures, India, along with the support of other like-minded developing countries, has been advocating in various international fora including that of CBD, WTO (World

Trade Organization) and WIPO (World Intellectual Property Organization), that Article 29 of the TRIPs (Trade-Related Aspects of Intellectual Property Rights) agreement dealing with disclosure in patent application should require **mandatory disclosure in patent application of the origin of biological resources / traditional knowledge** used in the technological invention, and an undertaking that the prevalent laws and practices of the country of origin have been respected. Incorporation of such a provision would reconcile the inherent contradictions in the provisions of TRIPs and CBD.

What are the legislations in India at national level for IPR on biological resources?

In India, at national level, we have the **Biological Diversity Act (2002)**. This act provides that prior approval of National Biodiversity Authority is necessary before applying for any kind of intellectual property rights (IPRs) based on any research or information on a biological resource obtained from India. 


Apart from that, in India, the **Patents (Second Amendment) Act** provides for **disclosure of the source** and geographical origin of the biological material / associated knowledge, used in an invention.

In case of non-disclosure or wrongful disclosure of source of biological material and associated knowledge, there are **provisions of opposition to the grant of patent or revocation of the patent**.

Is India successful in its doctrine at International Level?

India along with other developing countries is still pushing hard with these arguments but at the international level, the **proposal has not yet met with success in the TRIPs Council**. However, due to India's strong arguments in meetings under the aegis of the CBD as well as in WSSD (World Summit on Sustainable Development), the 7th Conference of Parties (CoP-7) to the CBD took a landmark decision regarding development of an international regime on access and benefit sharing, after almost ten long years of entry into force of the Convention.

✍ **The Nagoya Protocol is a major step towards strengthening India's stand and giving shape to the advocacy on access and benefit sharing.**

✍ The Access and Benefit sharing protocol, finalized at Nagoya recently, demonstrates the seriousness towards this standpoint of India. 

India and Biodiversity

✍ Some countries, lying wholly or partly within the tropics, are characterized by high species richness and more number of endemic species. These countries are known as **Mega diverse countries. India is one of the identified mega diverse countries of the World.**

✍ With only 2.4% of the land area, and accounts for 7-8% of the recorded species of the world. Over 45,000 species of plants and 91,000 species of animals have been recorded so far.

✍ India maintains this biodiversity while supporting 20% of the world's human and cattle population. The wide diversity in physical features and climatic situations has resulted in a diversity of ecosystems such as forests, grasslands, wetlands, coastal and marine (mangroves and coral reefs) and deserts. Among these, the forest ecosystem in particular exhibits tremendous variability ranging from temperate alpine to tropical wet evergreen forests.

- ✍ There are **16 major forest types** in India and it is also one of the eight primary centres of the origin of cultivated plants and is rich in agricultural biodiversity.
- ✍ India is an acknowledged centre of crop diversity, and holds 320 wild varieties of crop relatives mainly of rice, maize, millets, barley and brinjals.
- ✍ About **114 breeds of domesticated animals** (buffaloes, cattle, sheep, goat, camel, horses, donkeys, etc.) are also found in the country.
- ✍ India also has four of the 34 identified hot spots of the world, which are characterized by high degree of endemism and are therefore areas of global conservation concern.
- ✍ **Environment protection is enshrined in the Constitution of India itself in Article 48 A and Article 51A (g).**
- ✍ **National Biodiversity Action Plan 2008** draws upon the main principle in the NEP that human being are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature.
- ✍ In pursuance to the Convention on Biological Diversity (CBD), India had enacted the Biological Diversity Act in 2002 following a widespread consultative process over a period of eight years. The **Biological Diversity Rules** were noticed thereafter in 2004. **The Act gives effect to the provisions of the CBD.** It also addresses access to biological resources and associated traditional knowledge to ensure equitable sharing of benefits arising out of their use to the country and its people. India is one of the first few countries to have enacted such legislation. Twenty two State Biodiversity Boards have been established till date.

National Biodiversity Action Plan

In pursuance to Article 6 of the CBD, India within five years of ratifying the Convention had developed a National Policy and Macro level Action Strategy on Biodiversity in 1999. After approval of the National Environment Policy (NEP) in 2006, the 1999 document was updated and revised as the National Biodiversity Action Plan which was approved by the Cabinet in 2008.

- ✍ **The NBAP 2008 draws upon the main principle in the NEP that human being are at the centre of concerns of sustainable development and they are entitled to a healthy and productive life in harmony with nature.**

Biological Diversity Act



In pursuance to the Convention on Biological Diversity (CBD), India had enacted the Biological Diversity Act in 2002 following a widespread consultative process over a period of eight years. The Biological Diversity Rules were noticed thereafter in 2004. **The Act gives effect to the provisions of the CBD.** It also addresses access to biological resources and associated traditional knowledge to ensure equitable sharing of benefits arising out of their use to the country and its people. India is one of the first few countries to have enacted such legislation. Twenty two **State Biodiversity Boards** have been established till date.

Biodiversity Management Committees

Setting up of **BMCs** by all **local bodies** within their areas, for the purpose of promoting conservation, sustainable use and document of biodiversity is an **essential requirement under the Act**. So far, 29,150 Biodiversity Management Committees (BMCs) have been set up in eight States.

Like Minded Megadiverse Countries (LMMCs)

India recognizes the urgent need to develop human resources, capabilities, and legal and public policy to enable countries rich in biodiversity to take an active part in the new economy associated with the use of biological diversity and biotechnology.

In this context, **17 countries** rich in biological diversity and associated traditional knowledge have formed a group which is known as the Like Minded Megadiverse Countries (LMMCs).

The 17 countries are as follows:

Bolivia, Brazil, China, Colombia, Costa Rica, Democratic Republic of Congo, Ecuador, India, Indonesia, Kenya, Madagascar, Malaysia, Mexico, Peru, Philippines, South Africa, and Venezuela.

The LMMC group holds 60-70% of all biodiversity of the world. It is now well recognized as an important negotiating block in the UN and other international fora.

Centre for Biodiversity Policy and Law (CEBPOL)

CEBPOL refers to **Centre for Biodiversity Policy and Law**. The Ministry of Environment and Forests has decided to establish a Centre for Biodiversity Policy and Law (CEBPOL) in the **National Biodiversity Authority (NBA), Chennai**, which is a *statutory autonomous body* of the Ministry responsible for implementing the Biological Diversity Act, 2002.

✍ In this context, in November 2010, the **Government of Norway** has offered to provide technical and institutional collaboration for the CEBPOL.

✍ **Norway is the first developed country to have recently enacted a national legislation on ABS.**

The Norwegian partners for cooperation with NBA would be the Norwegian Directorate for Nature Management and Fridtjof Nansen Institute.

Objectives of CEBPOL:

1. To develop **professional expertise** in the complex and still-evolving policy and legal issues relating to biodiversity, including on access and benefit sharing, inter alia through research, development and training
2. To provide **advice and expertise to the Government** on these matters.

The setting up of this Centre is a very timely initiative taken by the Government, considering that the recently concluded Conference of the Parties to the Convention on Biological Diversity in Nagoya, Japan, has adopted a Nagoya Protocol on Access and Benefit Sharing. As a mega-diverse country, and as a victim of bio-piracy, India has played an important role in ABS negotiations.

United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) is another **projected** legally binding agreement produced at the United Nations Conference on Environment and Development (UNCED) or Earth Summit 1992.



The objective of UNFCCC is to **stabilize greenhouse gas concentrations** in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Is UNFCCC is legally binding?

No. UNFCCC is itself not legally binding and does not set mandatory limits on greenhouse gas emissions for individual countries and contains **no enforcement mechanisms**. However, it was projected legally binding agreement **as its protocols would set the emission targets and legally binding enforcements**. One such important protocol is the Kyoto Protocol, which is legally binding. The protocol is so famous that it is now a misnomer to UNFCCC itself.

Date of enforcement and members?

UNFCCC opened for signature on May 9, 1992 and entered into force on March 21, **1994**. Currently it has 192 parties.


The parties to the convention **meet annually** from 1995 in Conferences of the Parties (COP) to assess progress in dealing with climate change. Till now 16 Conferences have been concluded.

✓ The 1997, **Kyoto Protocol was concluded and established at the COP-3**. It is a **legally binding obligation for developed countries to reduce their greenhouse gas emissions**.

Secretariat

The Secretariat of UNFCCC is also known by the same name. Its offices are in **Haus Carstanjen, Bonn, Germany**. From 2006 to 2010 the head of the secretariat was Yvo de Boer. From May, 2010 his successor, Christiana Figueres from Costa Rica has been named.

Convention entering into force:

UNFCCC was opened for signature at the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. On June 12, 1992, 154 nations signed the UNFCCC. United States signed and later ratified the convention in 1994. 

✓ Having received the instrument of **ratification by a minimum of 50 parties**, the convention entered into force on March 21, 1994.

Classification of the Parties

The ratification of the UNFCCC means ratification of the voluntary "non-binding aim" to reduce atmospheric concentrations of greenhouse gases with the goal of "preventing dangerous anthropogenic interference with Earth's climate system."

The above action was primarily targeted at the industrialized countries, so that they stabilize the emissions of greenhouse gases at 1990 levels by the year 2000. Accordingly the Industrialized countries were placed in a separate category. The parties of the UNFCCC are grouped into three categories:

1. Annex-I Countries
2. Annex-II Countries
3. Developing Countries

Annex-I Countries:

The **industrialized countries and the countries whose economies were in transition** in 1992 were kept in Annex-I countries. This group comprises the **40 nations & one organization (European Union)** as follows:

Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, United States of America

Annex II Countries:

The **Developed countries which play a financial role** in the development of the developing countries and pay the cost for the development in the developing countries were placed in Annex II countries. The 23 Annex II countries are as follows:

Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States of America

✓ Please note that **Annex II is just a subgroup of the Annex I countries.**

Developing Countries:

The Developing countries, as per the UNFCCC, are **not required to reduce emission levels** unless developed countries supply enough funding and technology for their development.

Why no emission reduction targets for Developing countries?

This would avoid the restrictions on their development, because emissions are strongly linked to industrial capacity. The idea behind imposing a emission cut requirements for the Industrialized nations is that the developing countries can sell emissions credits to nations whose operators have difficulty meeting their emissions targets they get money and technologies for low-carbon investments from Annex II countries.

This has given rise to the issue between the Developed and Developing countries.

What is the issue?

It has been alleged by the opponents of the convention that it has created an unfair split between the developing and developed countries. They say that both the developing countries and developed countries need to reduce their emissions unilaterally. Some allege that the cost will stress their economy.

Conference of Parties→COP 1 to COP 3

1995 – COP 1, The Berlin

✓ The countries started making voices right from the COP 1 about the adequacies and abilities of the countries regarding meeting the commitments. The COP 1 was held in March 1995 at Berlin. The outcome was **Berlin Mandate**.

1996 – COP 2, Geneva, Switzerland

✓ COP 2 was held at Geneva in July 1996. The important outcome was that the scientific findings on climate change by **the Intergovernmental Panel on Climate Change (IPCC)** in its second assessment in 1995 were accepted.


✓ **1997 – COP 3, The Kyoto Protocol on Climate Change**

✓ COP 3 took place in December 1997 in Kyoto, Japan. The outcome was the famous Kyoto Protocol. The Kyoto Protocol was the legally binding protocol which outlined the greenhouse

gas emissions reduction obligation for Annex I countries. It also came out with some mechanisms collectively known as Kyoto mechanisms. These mechanisms include the Emissions Trading, Clean Development Mechanism (CDM) and Joint Implementation. The rest of the Protocols were as follows. Before we move on to them, we need to study the Kyoto Protocol in detail.

Kyoto Protocol

The Kyoto Protocol is a protocol (update) to the United Nations Framework Convention on Climate Change. It was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of July 2010, 191 states have signed and ratified the protocol.

Out of the 40 Annex-I countries, **37 countries have committed themselves** to a reduction of 6 gases 

1. four greenhouse gases (GHG) viz. carbon dioxide, methane, nitrous oxide, sulphur hexafluoride
2. Two groups of gases viz. hydrofluorocarbons and perfluorocarbons produced by them.

How much reduction?

The Annex I countries agreed to reduce their collective greenhouse gas emissions by 5.2% from the 1990 level. This limit **does not include the emissions by the International aviation and shipping.**

The above reduction is in addition to the industrial gases & chlorofluorocarbons committed under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer.

Why 1990 Benchmark?

The Benchmark 1990 emission levels were accepted by the COP 3 on the basis of the values of "**Global Warming Potential**" calculated for the IPCC Second Assessment Report.

Position of United States:

United States was the party to UNFCCC but it **rejected the Kyoto Protocol**. It was responsible for 36.1% of the 1990 emission levels of Annex I countries. The United States was required to reduce its total emissions an average of 7% below 1990 levels, but neither the Clinton administration nor the Bush administration sent the protocol to Congress for ratification.

- The Bush administration explicitly rejected the protocol in 2001.
- President George W. Bush said that the Kyoto Protocol is "economically irresponsible" and the United States will not ratify it.

Position of India, China, Brazil:

India, China and Brazil are considered to be the most advanced developing countries. They are in non annex group and they have no binding obligations in the Kyoto protocol to limit their CO₂ emissions. They have not yet made up their mind to sign the treaty as Annex-I countries and come within the ambit of the legal obligations to the CO₂ reductions.

Most Important Feature:

The establishment of **commitments** for the reduction of greenhouse gases that are legally binding for Annex I countries is the most important point of Kyoto Protocol and the very heart of it. The groups were made on the basis of the countries 1997 economic capacity to commit themselves and their industry.

Most important limitation

Only a few countries were made part of the Annex-I group. The changes in the economy in last 15 years have raised the issues such as India and China being the advanced developing countries must enter into it as Annex I countries. The rift between developing and developed countries continues as of now.

Kyoto mechanisms

Kyoto Mechanisms are also known as **Flexible Mechanisms** and they include Emissions Trading, the Clean Development Mechanism and Joint Implementation to lower the cost of achieving emission targets.

Please note that **Flexible Mechanisms and Carbon Sink** were included at the COP 6 at Bonn in Germany.

✓ **Emission Trading:** Emissions Trading-mechanism allows parties to the Kyoto Protocol to buy 'Kyoto units'(emission permits for greenhouse gas) from other countries to help meet their domestic emission reduction targets.



✓ **Joint Implementation:** Any Annex I country can invest in emission reduction projects (referred to as "Joint Implementation Projects") in any other Annex I country as an alternative to reducing emissions domestically.



✓ **Clean Development Mechanism (CDM):** Countries can meet their domestic emission reduction targets by buying greenhouse gas reduction units from (projects in) non Annex I countries to the Kyoto protocol.

Important Outcomes of other Conferences of the Parties COP 4 to COP 15

- ✓ 1998 – COP 4, Buenos Aires , Argentina
- ✓ 1999 – COP 5, Bonn, Germany
- ✓ 2000 – COP 6, The Hague, Netherlands
- ✓ 2001 – COP 6 bis, Bonn, Germany
- ✓ 2001 – COP 7, Marrakech, Morocco
- ✓ 2002 – COP 8, New Delhi, India
- ✓ 2003 – COP 9, Milan, Italy
- ✓ 2004 – COP 10, Buenos Aires, Argentina
- ✓ 2005 – COP 11/MOP 1, Montreal, Canada
- ✓ 2006 – COP 12/MOP 2, Nairobi, Kenya
- ✓ 2007 – COP 13/MOP 3, Bali, Indonesia
- ✓ 2008 – COP 14/MOP 4, Poznań, Poland
- ✓ 2009 – COP 15/MOP 5, Copenhagen, Denmark
- ✓ 2010 – COP 16/MOP 6, Cancún, Mexico
- ✓ 2011 – COP 17/MOP 7, South Africa



1998 – COP 4, Buenos Aires, Argentina

✓ Important issues were discussed. Nothing substantial decision came out.

1999 – COP 5, Bonn, Germany

✓ It was more a technical meeting. No substantial outcome.

2000 – COP 6, The Hague, Netherlands

✓ A major issue was discussed in this COP. It was the proposal of the United States in which it said that credit for carbon "sinks" should be allowed in forests and agricultural lands.

✓ This would satisfy a major proportion of the U.S. emissions reductions in this way. The countries were not able to met their emission targets and this caused an array of disagreements. The Talks collapsed in the

final days and the session was suspended without any kind of agreements. It was announced that the session would be resumed in Bonn Germany in 2001 as COP 6 bis.

2001 – COP 6 bis, Bonn, Germany

- ✓ When this session was called on, **George W. Bush had** become the President of the United States and had explicitly rejected the Kyoto Protocol.
- ✓ So US did not participate in this meeting. The most important outcome was that the **agreement over the Flexible Mechanisms and Carbon sinks**.
- ✓ Regarding Carbon Sinks, it was agreed that **credit would be granted** for broad activities that absorb carbon from the atmosphere or store it, including forest and cropland management, and re-vegetation, with no over-all cap on the amount of credit that a country could claim for sinks activities.

2001 – COP 7, Marrakech, Morocco

- ✓ The outcome of the session was a bundle of decision known as "**Marrakech Accords**". In this session US took part as an observer. By this time, the Kyoto Protocol was not put in force, as 55 countries had not ratified it.
- ✓ An Adaptation Fund was established, primarily in supporting developing countries better adapt to climate change.

2002 – COP 8, New Delhi, India

- ✓ Outcome of this session was the **Delhi Ministerial Declaration** which called the **developed countries to transfer technology** and minimize the impact of climate change on developing countries.

2003 – COP 9, Milan, Italy

- ✓ In this summit, the use to the Adaptation Fund was agreed.

2004 – COP 10, Buenos Aires, Argentina

- ✓ The important outcome of this session was the Buenos Aires Plan of Action. The steps taken in 10 years were also reviewed.

2005 – COP 11/MOP 1, Montreal, Canada

- ✓ The **Kyoto Protocol had entered into force** on 16 February 2005. So, next time, when the COP met, it was COP 11 and also known as MOP-1 (Meeting of Parties).
- ✓ It took place in between November 28 and December 9, 2005, in Montreal, Quebec, Canada. This was one of the largest meetings, in which more than 10 thousand delegates took part, making it one of the largest gatherings in Canada.
- ✓ **(Important)** Outcome of the meeting was the "**Montreal Action Plan**". The MAP called for an extension to the life of the Kyoto Protocol beyond its 2012 expiration date and negotiate deeper cuts in greenhouse-gas emissions. Thus it became the **basis of the negotiations for extending the Kyoto Protocol beyond 2012.**

2006 – COP 12/MOP 2, Nairobi, Kenya

- ✓ A five-year plan of work to support climate change adaptation by developing countries was adopted and agreed on the procedures and modalities for the Adaptation Fund.

2007 – COP 13/MOP 3, Bali, Indonesia

- ✓ By this time, extension of the Kyoto Protocol beyond 2012 had become an important point of discussion. In this meeting, an **Ad Hoc Working Group** on Long-term Cooperative Action under the Convention (AWG-LCA) was established as a **new subsidiary body** to conduct the negotiations aimed at urgently enhancing the implementation of the Convention up to and beyond 2012.

2008 – COP 14/MOP 4, Poznań, Poland

2009 – COP 15/MOP 5, Copenhagen, Denmark

- ✓ By this time the overall goal for the COP 15 had become to establish an ambitious global climate agreement for the period from 2012 onwards when the first commitment period under the Kyoto Protocol expires.
- ✓ By this time, it is clear that many **Annex I countries are reluctant** to fulfill the commitments under the **Kyoto Protocol**.
- ✓ The result is that a greater diplomacy has started for laying the foundation of the post-Kyoto Protocol agreement.
- ✓ By this time, the standpoint of United States came as biased towards a less specific “politically binding” agreement.

2010→COP 16/MOP 6, Cancún, Mexico

2010 United Nations Climate Change Conference was held in Cancún, Mexico, from 29 November to 10 December 2010. This was the 16th session of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), so referred as COP 16. This was also the 6th session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, so referred as CMP6.

Background of the Summit:

On 18 December 2009 at the end of the COP 15 / MOP5 which was held at Copenhagen, Danish Capital a "Non binding Copenhagen Accord" was put forth. The disappointment of the COP-15 which could not produce a climate agreement at the Danish Capital had already raised the doubts whether a long running 194 nation's talk would ever agree on a legally binding treaty for combating Global Warming.

- ✓ The core failure of the COP meetings is in finding a consensus formula for mandatory reductions in the countries' emission of carbon dioxide and other global warming gases.

Agenda of the Summit:

The Global sentiments after COP15 had left little chances for a substantial outcome from the COP 16.

- ✓ It was already expected that a legally binding agreement would not come out from the Cancun summit.
- ✓ So the main standoff was not expected to get resolved.
- ✓ The **focus was on secondary** "building Blocks" such as **climate financial aid**, combating **deforestation** and other matters.
- ✓ The agenda was also to build a momentum towards an umbrella deal going to happen at South Africa or possibly the Earth Summit 2012 at Rio de Janeiro.

Role of United States:

It's a reality that a global agreement on climate cannot put much of the dent in world's CO₂ emissions without the help of the world's largest emitter United States.

- ✓ The previous Bush regime continued to oppose the mandatory emission reduction targets, leaving option for voluntary reduction targets with no teeth.
- ✓ The takeover of the US house of representatives by the Republicans further resulted in dismissal of the evidence of the Human Caused warming and thus ruling out US action for at least 2 years.

Green Fund:

The agenda for Cancun was also an agreement on a "Green Fund" to disburse the aid that the developed countries promised at Copenhagen i.e. \$ 100 billion a year by 2020 for the developing countries to adapt the climate change by building the seawalls and shifting farming patterns and also to install clean energy sources.

- ✓ The Developing countries expected better terms for transfer of patented green technology from the developed nations.

Ambo declaration

Prior to the COP 16, an Ambo declaration was adopted at the Tarawa Climate Change Conference on the 10th November 2010 by Australia, Brazil, China, Cuba, Fiji, Japan, Kiribati, Maldives, Marshall Islands, New Zealand, Solomon Islands and Tonga. This declaration called for an immediate action to be undertaken to address the causes and adverse impacts of climate change. The United States, the United Kingdom and Canada, who also attended the conference, chose not to be part of the declaration by taking Observer status.

Outcome of the Summit:

The nations, as expected failed to adopt a binding climate treaty. The outcome of the summit was a nonbinding agreement which calls on the rich countries to cut their GHG emissions by the amounts the pledged one year ago at the COP15. Again, these cuts are not legally binding.

- ✓ The agreement came up with a Green Fund and \$ 100 billion a year that the wealthier countries would provide to the poorer countries to finance the programmes to cut emissions and cope with the drought and other methods.

India's Viewpoint:

India had its previous position of not any acceptance to the "binding emission cuts" but softened saying that it would consider in agreeing to the mandated cuts at some point in the future.

- ✓ Our Minister said that "all countries must take binding commitments under appropriate legal forms" to control their emissions of greenhouse gases (GHG).
- ✓ This was looked as a departure from India's previous stand that it would not accept legally binding emission cuts.
- ✓ It was declared "unacceptable" by the Indian Parliament in 2009.
- ✓ The Minister has come under fire by the opposition parties which alleged that Jairam not only broken alliances with China, but also compromised India's interest. These parties have asked the Government to come up with explanation of this renewed stand

2011 – COP 17/MOP 7, South Africa

- ✓ The 2011 COP 17 is to be hosted by Durban, South Africa, from November 28 to December 9, 2011 

India & the Kyoto Protocol

The Government of India had decided to ratify the Kyoto Protocol in 2002 after 77 countries had ratified the Protocol. India was not required to reduce emission of Green House Gases under the Protocol under which basically the developed countries were required to reduce emissions of GHG by an average of 5.2 per cent below 1990 level by 2012.

Being in Developing & Non-annex countries, India ratified the convention to seek benefit from transfer of technology and additional foreign investments when the Kyoto Protocol comes into force. This was expected to be followed by new investments in renewable energy, energy generation and efficiency promotion and afforestation projects.

India is fully committed to the Kyoto Protocol and has now recently been very active in the talks for further emission reduction commitments of Annex-I Parties in the Second Commitment Period (Post 2012). The talks are undergoing since 2004, from COP-10, Argentina, when for the first time, discussions on the post-Kyoto mechanism, on how to allocate emission reduction obligation following 2012 started.

✓ India, along with South Africa and 35 other like minded countries has submitted a proposal calling for Annex-I Parties to agree **to at least 40% emission reduction commitment** by 2020 as compared to their 1990 levels.

India has been one of the major beneficiaries of the Clean Development Mechanism (CDM), a flexible mechanism under the Kyoto **Protocol** and would like that this mechanism to continue and be further strengthened.

Kyoto Units

The emissions trading can be international or domestic. Under the **International Emissions Trading (IET)**, the countries can trade in the **international carbon credit market** to cover their shortfall in Assigned amount units. Countries with surplus units can sell them to countries that are exceeding their emission targets under Annex B of the Kyoto Protocol. This are mentioned in article 17 of the Kyoto Protocol.

Assigned amount units / Kyoto Units

The Assigned Amount Unit of AAU refers to an **allowance to emit** greenhouse gases comprising **one metric ton of carbon dioxide equivalents** calculated using their Global Warming Potential. The name is synonymous with **Carbon Credit or "Kyoto Units"**.

Certified Emission Reductions (CERs)

Certified Emission Reductions are **one of the types of the Kyoto Units**. They are **issued under the Clean Development Mechanism**.

The Annex-I countries can use the CERs to comply with their emission limitation targets or by operators of installations covered by the European Union Emission Trading Scheme (EU ETS) in order to comply with their obligations to surrender EU Allowances, CERs or Emission Reduction Units (ERUs) for the CO₂ emissions of their installations. The Government and Private entities can hold the CERs on electronic accounts with the UN.

Types of CERs

There are two types of CERs based upon their likely duration of benefit. They can be long duration (lCER) or temporary (tCER). The original entity that makes the reduction can sell both of them in the primary market. When they are resold, it becomes the secondary market. The approved CERs are recorded in CDM Registry accounts.

CERT

CERT refers to the "Carbon Emission Reduction Target". The term is used in United Kingdom, where it was earlier known as Energy Efficiency Commitment. The target is imposed on the gas and electricity transporters and suppliers under Section 33BC of the Gas Act 1986 and Section 41A of the Electricity Act 1989, as modified by the Climate Change and Sustainable Energy Act 2006.

White Certificates

In US and UK, the Energy Savings Certificate (ESC), Energy Efficiency Credit (EEC) are known as White Certificates or White Tags. They are issued by the authorities and are documents certifying that a certain reduction of energy consumption has been attained. The White Certificates are tradable and are combined with an obligation to achieve a certain target of energy savings.

Joint Implementation

Joint Implementation is based upon the Article 6 of the Kyoto Protocol. Under article 6, any Annex I country can invest in emission reduction projects in any other Annex I country as an alternative to reducing emissions domestically. The **idea is to lower the cost of complying with their Kyoto targets** by investing in greenhouse gas reductions in an Annex I country where reductions are cheaper, and then applying the credit for those reductions towards their commitment goal.

Clean Development Mechanism

Out of the three mechanisms under the **Kyoto Mechanisms**, the **Clean Development Mechanism** is most popular. It is defined by the **Article 12 of the Kyoto Protocol**.

Objectives:

There are two broad objectives of the CDM as follows:

1. To help the Non-Annex parties in achieving sustainable development and in contributing to the ultimate objective of the UNFCCC, i.e. to prevent the climate change.
2. To help the Annex parties to achieve compliance with their quantified emission limitation and reduction commitments.

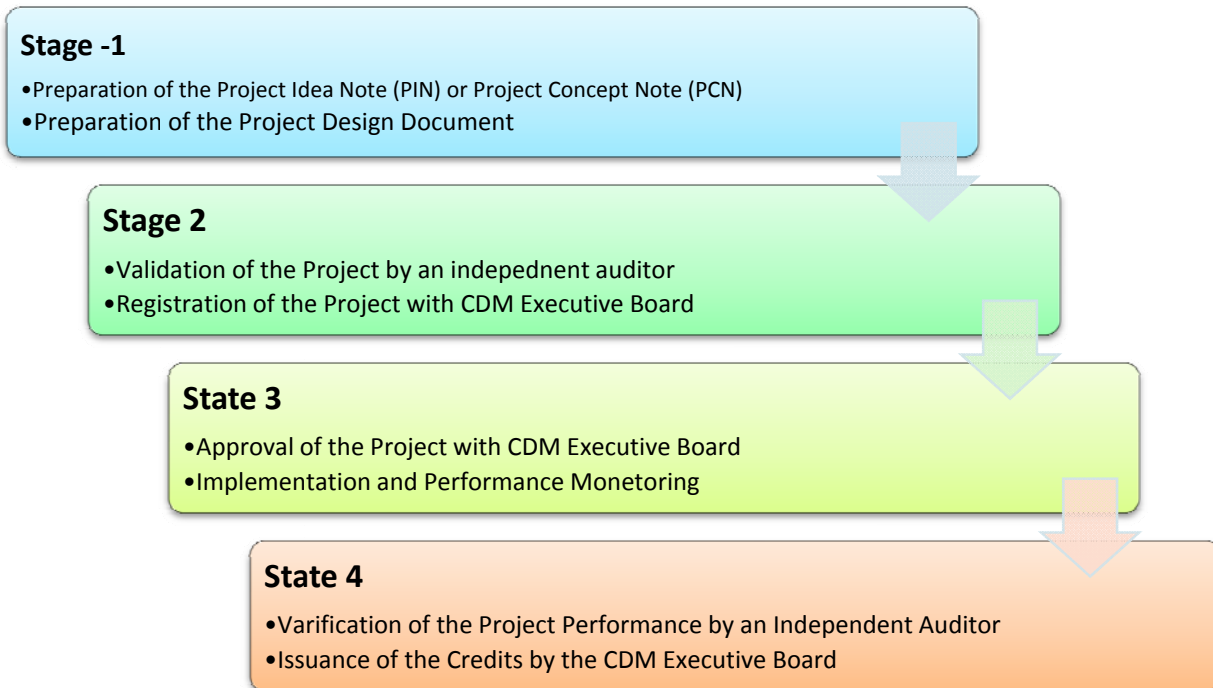
Benefits

The benefits of the CDM are shown in the following graphics:



Process:

The Process is shown in the following simple graphics:



The above graphics presents the classical structure of the CDM which uses project-by-project process for registering and verifying projects. This Clean Development Mechanism process not only takes a long time but also has high transaction costs as a result of which it has **not been very attractive for energy efficiency projects**, which are usually small in terms of investments. There is also a high risk of non registration associated with it.

✓ The countries which are less developed or least developed and the small island states where average project sizes and the scale of national markets tend to be smaller, the relative transaction costs are higher.

To address this problem, the CDM Executive Board launched the **Programme of Activities (PoA)** modality.

Programme of Activities (PoA)

Under this modality, a PoA Coordinating/Managing Entity (CME), which can be a government agency, NGO or business, develops a PoA which defines broad parameters for project activities. These activities are called **CDM Programme Activities** or CPAs. Whereas stand-alone CDM projects must be approved individually by the CDM Executive Board, a **PoA needs to be registered only once** by the CDM Executive Board. After that, it can include an unlimited and unspecified number of individual CPAs without recourse to the CDM Executive Board. It is expected that the **PoA will reduce the transaction cost** as the **umbrella project registration** will allow smaller projects to be included without going through the entire process of due diligence. This would enable the private investors to get CDM revenues in an expeditious manner. The registration will pave the way for an accelerated implementation of the scheme.

In India, one such example of PoA is **Bachat Lamp Yojna**.

Bachat Lamp Yojna as a PoA

- ✓ **Bachat Lamp Yojana** is the largest PoA to be implemented in India and was the largest PoA registered with CDM executive Board, when it was registered in May 2010.
- ✓ The scheme was developed by the **Bureau of Energy Efficiency (BEE)** under the aegis of the Ministry of Power and was launched in February 2009.
- ✓ In May 2010, the scheme was registered under the Clean Development Mechanism (CDM) of the Kyoto Protocol.

Developed to promote energy efficient lighting in India, BLY promotes **replacement of inefficient bulbs** with Compact Fluorescent Lamps (CFLs) by leveraging the **sale of Certified Emission Rights (CERs)** under the CDM.

How does BLY work?

Under the BLY scheme, qualities CFLs are distributed to grid-connected residential households in exchange of an incandescent lamp (ICL) and INR 15. This means that any house hold can give a Bulb + Rupees 15 /- to get a CFL. CFL cost is around 8-10 times of the Bulb so this Yojna basically removes the first cost barrier.

To handle the problem of High Transaction Costs of preparation and registration of CDM projects and for wider reach and faster implementation, BEE developed a Programme of Activities (PoA) which would serve as an umbrella CDM project.

- ✓ A tripartite agreement works in the background between the BEE, Distribution Companies (DISCOMs) and CFL suppliers.

The implementation of this project turns out to be the largest PoA in terms of carbon dioxide emission reductions, to be ever registered by the CDM Executive Board.

All other individual projects are designed to be in conformance of with the umbrella project and they are added to the umbrella project as and when they are prepared.

- ✓ The replacement of all the 400m incandescent lamps (ICLs) by CFLs would lead to a potential reduction of over **6,000 MW** in electricity demand.

The current penetration of CFL in the household sector remains low at about 5-10 per cent largely due to the high price of the CFLs, which is 8-10 times the cost of incandescent bulbs. The Bachat Lamp Yojana focuses on

this first cost barrier to reduce the cost of CFLs to that of incandescent bulbs for consumers. At Rs 15 a piece for CFLs, the BLY is a win-win situation for all.

Carbon Leakage

Carbon Leakage is another issue with the Clean Development Mechanism. It is defined as increase in emissions outside a region as a direct result of the policy measures to cap emission in this region.

- ✓ This means that the domestic climate mitigation policy is less effective and more costly in containing emission levels, a legitimate concern for policy-makers.
- ✓ One example of the stringiest policies is Carbon Tax, or Carbon Cess applicable in many countries.

How does Carbon Leakage work?

We take an example of two countries A and B.

- ✓ **Country A** has a very strict emission policy and due to its stringent policy, the costs involved in the production increases.
- ✓ **Country B** has a less strict and flexible emission policy and due to this flexible policy, the costs involved in the production are less as compared to country A, keeping all other factors constant.

So, a company located in country A faces increased costs due to emissions pricing as a result of the strict climate policy. The company would take some action and as a result may decide to go for reducing, closing or even relocating the production to Country B with less stringent climate policies. This means that the Country A was though able to cut emissions, but now Country B will increase the emissions due to transfer of greenhouse gas intensive industries from Country A to B. The result is more Green House Gases emission and more industrial jobs.

- ✓ This shift may be from Country to Country, Province to Province, Region to Region or any other way out.

Bali Action Plan

Bali Action Plan or Bali Roadmap was adopted after the 2007 United Nations Climate Change Conference (COP-13/ MOP-3) on the island Bali in Indonesia in December, 2007. This was a two-year process to finalizing a binding agreement in 2009 in Copenhagen.

The important parts were:

1. An Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol negotiations
2. Launch of the Climate Adaptation Fund
3. Review of the scope and content of the Article 9 of Kyoto Protocol to make decisions on technology transfer and on reducing emissions from deforestation.

Negotiations are currently underway to determine the quantified emission reduction targets of the Parties to Kyoto protocol for the second commitment period beginning from 2013 and also define the targets of emission reduction for US, comparable with other Kyoto Parties, in pursuance of Bali Action Plan.

According to the Bali Road Map, a framework for climate change mitigation beyond 2012 was to be agreed there in the COP 15 at Copenhagen Summit, in 2009. However, an agreement was not reached in the same conference nor in the COP 16 at Mexico.

Carbon Tax

The tax that is levied on the carbon content of fuels is called Carbon Tax. So, in Carbon Tax, the burning of fossil fuels viz. coal, petroleum products such as gasoline and aviation fuel, and natural gas is taxed in proportion to their carbon content.

The result is an increase in the competitiveness of non-carbon technologies compared to the traditional burning of fossil fuels. It directly helps to protect the environment while raising revenues.

Carbon Tax in India

In July 2010, India also introduced a nationwide carbon tax of 50 rupees per metric tonne of coal both produced and imported into India. India's total coal production is estimated to be around 571.87 million tons in the year ending March, 2010. Apart from that India imports around 100 million tons of coal every year. Half of India's energy demand is fulfilled by coal only. The Carbon Tax was imposed with an expected raise of an amount 25 billion rupees for the financial year 2010-2011. This money would be used to establish and fund the National Clean Energy Fund (NCEF).

Pigou Club

The economists who publically advocated the taxes such as Carbon Tax and Gasoline Tax came together and created a club which is known as Pigou Club. The term comes from the name of an economist Arthur Cecil Pigou and is known as Pigovian tax which is levied to correct the negative externalities (negative side-effects) of a market activity. The idea of the club members is called Green Shift or Eco Tax.

Depletion of Ozone Layer

Ozone or Trioxygen is an allotrope of oxygen that is

1. **much less stable** than the diatomic allotrope (O₂)
2. **Paramagnetic** compared to the Diamagnetic O₂.
3. Present in **low concentration in atmosphere** and has **harmful effects** on the respiratory systems of animals
4. **Creates Ozonosphere** in the upper atmosphere and is beneficial, preventing potentially damaging ultraviolet light from reaching the Earth's surface. Ozonosphere is located 10-18 kilometers of Earth's surface.

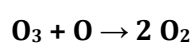
Creation and Destruction of Ozone:

Ozone Layer is the part of the Stratosphere located between 10 to 50 kilometer above the surface.

- ✓ Here, in presence of the ultraviolet wavelengths (less than 320 nm), it is made by the decomposition of the O₂ molecules as follows:



- ✓ It is destroyed by the reaction with atomic oxygen:

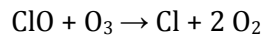
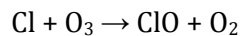
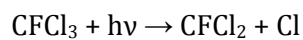


- ✓ This action is catalyzed in presence of free radicals such as hydroxyl (OH), nitric oxide (NO) and atomic chlorine (Cl) and bromine (Br).

- ✓ The overall amount of ozone in the stratosphere is determined by a balance between photochemical production and recombination. The Depletion of the Ozone layer is because of imbalance in the photochemical production and recombination.

Ozone Depletion:

Creation of Ozone in presence of the most harmful ultraviolet rays of sun light **wavelengths (280-315 nm)** stops them from passing through the Earth's atmosphere. But Ozone can be **destroyed by the free radical catalysts** such as hydroxyl radical (OH·), the nitric oxide radical (NO·), atomic chlorine (Cl·) and bromine (Br·). The above free radicals are created naturally or also anthropogenically. Out of them, the levels of chlorine and bromine have increased due to human activities. The **Chlorofluoro Carbons (CFCs)** are their main sources. Once in the stratosphere, the **Cl and Br atoms are liberated from the parent compounds by the action of ultraviolet light and destroy Ozone as follows:**



In the above reactions, it is seen that the Cl radical is produced again and this radical keeps on destroying the ozone molecules for a **period of 2 years**. If we compare Bromine and Chlorine, **Bromine is more efficient in this reaction.**

Dobson units in context with Ozone Depletion

Please note that ozone in the atmosphere can be measured in the PPT but that is not the units of Ozone Depletion. **The Ozone hole is measured in terms of reduction in the total column ozone, above a point on the Earth's surface, expressed in "Dobson units".**

- ✓ One DU is 2.69×10^{16} ozone molecules per square centimeter, or 2.69×10^{20} per square meter or 0.4462 milli moles of ozone per square meter.
- ✓ **The base unit for an ozone hole was fixed 220 DU** because total ozone values of less than 220 Dobson Units were not found in the historic observations over Antarctica prior to 1979.

The instrument used for adjudging the decreases in column ozone in the Antarctic spring and early summer compared to the early 1970s was **Total Ozone Mapping Spectrometer (TOMS).**

The observed and projected decreases in ozone have generated worldwide concerns. This led to adoption of the Montreal Protocol that bans the production of CFCs and halons as well as related ozone depleting chemicals such as carbon tetrachloride and trichloroethane.

Vienna Convention for the Protection of the Ozone Layer 1985

This was the first multilateral Environmental Agreement in context with the Ozone depletion. It was agreed upon at the Vienna Conference of 1985 and entered into force in 1988, thus paving the way for a **legally binding treaty as its protocol called Montreal protocol**. Please note that **Vienna Convention itself has not placed legally binding reduction goals for the use of CFCs.**

Montreal Protocol 1989

"Montreal Protocol on Substances That Deplete the Ozone Layer" or simply Montreal Protocol is the protocol to the Vienna Convention for the Protection of the Ozone Layer. This international treaty was designed to protect the ozone layer by phasing out the production of substances believed to be responsible for ozone depletion.

- ✓ Opened for signature on September 16, 1987
- ✓ Ratified by 196 Countries
- ✓ Entered into force on January 1, 1989.
- ✓ First meeting in Helsinki, May 1989.
- ✓ Total Revisions till now : 7
- ✓ Last amendment : Beijing
- ✓ Last amendment ratified by 154 countries.

The Montreal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere—chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform—are to be phased out by 2000 (2005 for methyl chloroform). These compounds significantly deplete the stratospheric ozone layer that shields the planet from damaging UV-B radiation. To date, 191 countries have signed the Protocol. As per the latest amendment, the treaty calls for complete phase out of HCFC by 2030.

✗ It is believed that if the international community adheres to this treaty, the ozone layer will be recovered by 2050. Thus this protocol is hailed as most successful international agreement to date.

Theme of Montreal Protocol:

The Montreal Protocol revolves around the CFCs. Under the Protocol, the Executive Committee (ExCom) 53/37 and ExCom 54/39 and Parties to this Protocol agreed to set year 2013 as the time to freeze the consumption and production of HCFCs under a Hydrochlorofluorocarbons (HCFCs) Phase-out Management Plan (HPMP). They also agreed to start reducing its consumption and production in 2015. The time of freezing and reducing HCFCs is then known as 2013/2015.

✓ To provide funds and help developing countries in this phase out programme, a Multilateral Fund for the Implementation of the Montreal Protocol has been established.

Montreal Protocol: HCFC versus HFC

✗ Please note that Montreal Protocol currently calls for a complete phase-out of HCFCs (Hydrochlorofluorocarbons) by 2030, but does not place any restriction on HFCs (Hydrofluorocarbons).

✗ The difference between them is of Chlorine.

✗ Hydrofluorocarbons contain only one or a few fluorine atoms are the more common type of organofluorine compounds used as refrigerants, their atmospheric concentrations are rapidly increasing, causing international concern about their rising contribution to anthropogenic radiative forcing emissions. All the HCFCs, HFCs & CHCs are now considered to be the Global Warming Potential.

International Ozone Day

✗ The Montreal Protocol opened for signature on September 16, 1987. This date is observed as International Ozone Day every year.

India and Montreal Protocol:

India became a party to the Montreal Protocol in 1992 and has been sharing the global concern for phasing out Ozone Depleting Substances. India has emerged as a global leader in promoting smooth transition for phasing out Ozone Depleting Substances (ODS). India is continuing dedicated efforts for generating awareness among all stakeholders on the importance of the Protocol. India has fulfilled all the commitments of the Montreal Protocol and has significantly reduced chlorofluorocarbon production and consumption.

In 2007 India was bestowed with Montreal Protocol Implementers Award. India has achieved 50% reduction target of CFC production from 22558MT and consumption from 6681MT to 1940 MT as on 1.1.2005. The critical target of 85% reduction of CTC production and consumption also has been achieved by 2007. India has been a beneficiary of the Multilateral Fund (MLF) for phase-out of ozone depleting substances such as CFC, CTC, Halon and methyl chloroform.

Persistent Organic Pollutants (POPs)

Persistence is an important characteristic of the environmental pollutants in an environmental medium (air/ water/ soil) or in a living tissue, in which the pollutants remain active for a longer time in a toxic form through chemical, biological, and photolytic processes.

Persistent organic pollutants (POPs) are organic compounds that, to a varying degree, resist photolytic, biological and chemical degradation.

Due to persistence, the pollutants are capable of long-range transport, **bioaccumulation** and **biomagnification**.

Most of the POPs include pesticides, Industrial solvents, polyvinyl chloride, and pharmaceuticals.

The Other words used are PBTs (Persistent, Bioaccumulative and Toxic) or TOMPs (Toxic Organic Micro Pollutants.)

Dirty Dozen

In May 1995, the United Nations Environment Programme Governing Council (GC) started investigations on the POPs. The process began with 12 POPs which were most common at that time. They were called "Dirty Dozen".

The Dirty Dozen are:

aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, and toxaphene.

The list enlarged later with inclusion of some more chemicals.

Common Characters of the POPs

They are mostly having:

1. **Low Water solubility**
2. **High lipid solubility: This property leads them to bioaccumulation in animal tissues.**
3. **Semi volatile:** The property of their physico-chemical characteristics that permit these compounds to occur either in the vapour phase or adsorbed on atmospheric particles, thereby facilitating their long range transport through the atmosphere

✓ The POPs with **higher Molecular weights are more toxic and more persistent** generally .

- ✓ Most of the POPs are **halogenated** and many have **Chlorine** as a component.

Bio-accumulation, Bio-concentration and Bio-magnification

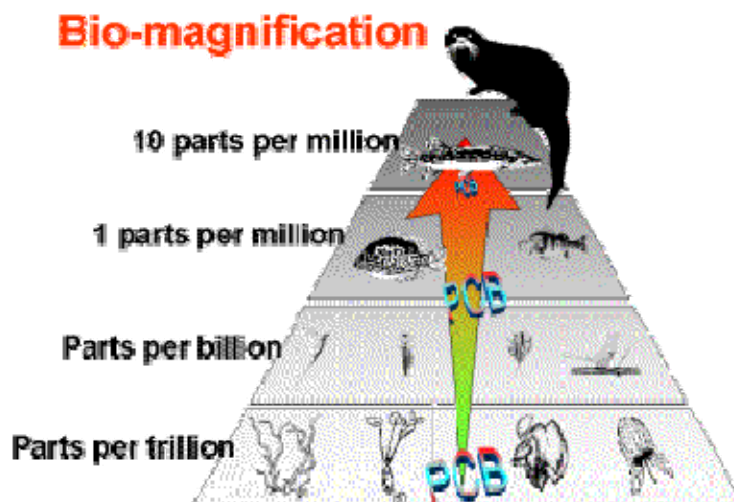
The three terms given above with prefix Bio are different with each other.

- ✓ **Bio-accumulation** refers to increase in concentration of a substance in certain tissues of organisms body.
- ✓ While **Bioaccumulation** occurs when an organism absorbs a toxic substance **from all sources** at a rate greater than that at which the substance is lost. **Bioconcentration** occurs when an organism absorbs a toxic substance **from ONLY Water** at a rate greater than that at which the substance is lost.

Please note that Bioaccumulation and Bioconcentration are synonymous except the difference of the source. **Both Bioaccumulation and Bioconcentration occur in the same organism.** But **Biomagnification occurs across various trophic levels in a food chain.**

Biomagnification

Biomagnification refers to the is the INCREASE in concentration of the POPs such as DDT, that occurs in a food chain **as a consequence of persistence, high lipid solubility and low water solubility.** The substances become more and more concentrated in tissues or internal organs as they move up the chain. This is shown in the following picture:



Stockholm Convention on Persistent Organic Pollutants

Stockholm Convention is first ever-concerted global effort to save mankind from the adverse impact of Persistent Organic Pollutants (POP). It was called in **1995** by the Governing Council of the **United Nations Environment Programme (UNEP)**, following its study on the Dirty Dozen. The Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme on Chemical Safety (IPCS) prepared an assessment of dirty dozen. The negotiations began in 2001 and the **convention came into being in 2004** after ratification by 128 parties.

The convention calls to **outlaw nine of the dirty dozen chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans.** As of January 2011, there are 172 parties to the Convention.

- ✓ The convention listed **twelve distinct chemicals in three categories** in the beginning.

- ✓ These includes 8 pesticides (aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene); two industrial chemicals (poly chlorinated biphenyls and hexachlorobenzene) and two unintended byproducts (poly chlorinated dibenzo-p-dioxins and dibenzo furans, commonly referred to as dioxins and furans).
- ✓ Countries are required to make efforts to **identify, label and remove PCB**-containing equipment by the year **2025**, and manage the wastes in an environmentally sound manner, not later than **2028**.
- ✓ The Convention also seeks to continue minimization and, where feasible, ultimate elimination of the releases of unintentionally produced POPs, such as dioxins and furans. Stockpiles and wastes containing POPs must be managed and disposed off in a safe, efficient and environmentally sound manner, taking into account international rules, standards and guidelines. Each Party is **required to develop a plan** for implementing its obligations under the Convention.

India and Stockholm Convention:

India's Union Cabinet gave its approval to ratify and accede to the Stockholm Convention on Persistent Organic Pollutants on 20 October **2005**.

The Convention will enable India to participate in the It will also enable India to avail **technical and financial assistance** for implementing measures to meet the obligations of the Convention.

Stockholm Convention and Endosulphan:

Endosulphan is used as an organochlorine insecticide and **acaricide (killing ticks and mites)**. **Endosulphan belongs to organochlorine group of pesticides such as DDT**. It causes **endocrine disruption and neurotoxic impacts**. It is also supposed to be a **genotoxic** and may lead to **genetic mutation**, however, it has not been found to be a **carcinogenic**.

- ✗ Because of its threats to environment as a POP, it is banned in more than 63 countries but still is widely used.
- ✗ In India it is produced by Hindustan Insecticides Limited.
Currently, a global ban on the use and manufacture of endosulfan is being considered under the Stockholm Convention.
- ✗ India is the largest user of Endosulphan.
In India, Endosulphan was put on hold in Kerala due to some peculiar health impacts seen after aerial spray of in **Cashew Plantations in Kerala**. In other states there are approved manners of usage. There have been conflicting views on the usage and impacts of Endosulphan. The officials say that there is lack of full scientific certainty about its health and environment impacts. However, the environment activists say that the nexus of the government with the insecticide lobby leads to the stern stand of the Government.
- ✗ India's stand was not clear in the Persistent Organic Pollutants' Review Committee (POPRC) of the Stockholm Convention that began in Geneva, Switzerland that held in October 2010.
In India, the Kerala Government demanded the ban on the pesticide as at least a few hundred people have died of poisoning caused by the chemical. Many face a wide range of genetic abnormalities and other health problems.

Mayee committee of Kerala

Mayee committee was established by the United Democratic Front government in the state and it established that no link had been established between the use of Endosulfan in the cashew plantations of the State-owned Plantation Corporation of Kerala and the health problems. So it was the state Government that sent this report to center. But after that things have changed a lot. The Mayee committee had recommended the conduct of a comprehensive, well-designed and detailed health and epidemiological study in the entire plantation area. However, nothing was done in that direction for the past five years.

✍ However, the Non Governmental agencies have found that in Kasaragod district in Kerala, sustained exposure to Endosulfan resulted in congenital, reproductive, long-term neurological damage and other symptoms. There were observations of similar effects in animals: cows giving birth to deformed calves, cows and chickens dying inexplicably, domestic animals with miscarriages, bleeding, infertility, stunting of growth and deformities, as well as fish kills and dwindling populations of honeybees frogs and birds.

Hazardous substances

The Hazardous material or Hazmats are the solids, liquids and gases which can harm people, organisms, property and environment. The Hazardous Materials are often subject to various legislations. The Hazmats may be radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, biohazardous, toxic, pathogenic, or allergenic.

International Programme on Chemical Safety

In 1980, the **three UN bodies viz.** World Health Organization, the International Labour Organization and the United Nations Environment Programme formed the "International Programme on Chemical Safety". The idea was to establish the basis of safe use of the chemicals and strengthen the national capabilities for chemical safety.

✓ Under this framework of this programme, the WHO publishes the Concise International Chemical Assessment Document, describing the toxicological properties of the chemical substances.

Rotterdam Convention



The most important international convention in context with the Hazmats is Rotterdam Convention.

Formal name of the multilateral Rotterdam Convention is "*The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*".

This convention was signed on September 10, 1998 and became effective from February 24, 2004.

Theme of this convention is to promote **shared responsibilities** in relation to importation of hazardous chemicals. It promotes open exchange of information, proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans.

The Rotterdam Convention is **not a legally Binding convention** and the parties 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. Most important Hazmats such as 245-T, Aldrin, Asbestos, DDT etc. are covered under this convention. It has 128 parties.

- ✓ India also ratified the Rotterdam Convention on Prior Informed Consent Procedure for certain hazardous Chemicals and Pesticides in International Trade on May 24, 2006. India is now party to both the conventions viz. the Stockholm Convention and the Rotterdam Convention.

Marine Pollution

Spread of chemicals, particles, industrial, agricultural and residential waste, noise or the invasive organisms in the marine is the Marine Pollution. The Toxins bioaccumulate in Zooplankton and phytoplankton; and then get biomagnified in the ocean food chains. They cause Eutrophication, ocean acidification etc. leading to problems such as algal bloom, hypoxia and anoxia.

There are four main types of inputs of pollution into the ocean:

1. Direct discharge of waste into the oceans such as rivers
2. Runoff into the waters due to rain
3. Pollutants that are released from the atmosphere
4. Ship Pollution which includes many ways including the oil spills.

London Convention

The London Convention or LC-72 has the formal title of "*Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*". This convention was signed in 1972 and entered into force in 1975. It has 78 parties. India is not a party to this convention.

This is a **non-legally binding convention** which covers the problem of deliberate disposal at sea of wastes or other matter from vessels, aircraft, and platforms. But it does not cover discharges from land-based sources such as pipes and outfalls, wastes generated incidental to normal operation of vessels, or placement of materials for purposes other than mere disposal, providing such disposal is not contrary to aims of the Convention.

One regional type of convention is Barcelona Convention, which covers the same problems in the Mediterranean sea.

Cultural Eutrophication

When the process of Eutrophication is increased by the human activities, it is called cultural Eutrophication.

This is because the human activities (mainly development in nature) increase the surface run off and the nutrients such as Phosphates, Nitrates are supplied to the Ocean water. They may be supplied by Constriction works, treatment plants, golf courses, fertilizers, and farms.

Mercury Poisoning in Fishes

Fishes concentrate mercury in their bodies, often in the form of methylmercury, a highly toxic organic compound of mercury. The mercury is absorbed, usually as methylmercury, by algae at the start of the food chain. It gets magnified to about 0.01 ppm in the herring, tuna etc. The same fishes when consumed by the human get more concentration of mercury. In Sharks, the mercury gets accumulated to the extent of 1 ppm.

Minimata Disease

The disease was searched in the seaside town of Minimata, in Japan in late 1950s when a strange behavior in animals was seen. The abnormal behavior was seen in the Cats, Birds and also in Humans. Investigations

found that a petrochemical company had been **discharging mercury waste** into the sea. Around 5,000 people were killed and perhaps 50,000 have been to some extent poisoned by mercury. Thus, this disease got famous as Minimata disease.

Oil Spills

In Oil Spills, the oil is released into the ocean or coastal waters. The Oil may be crude oil from the tankers, offshore platforms, drilling rigs, Oil wells, ships or in any other form.

Impacts on Marine Life:

- ✓ **Plumage:** The most important impact of the oil spills on the sea organisms is on the **plumage of the birds**. The seabirds, when their plumage gets penetrated by the oil, the insulating ability is reduced drastically and the birds become vulnerable to minor change in temperature. The oil penetration also makes them less buoyant in water.
- ✓ **Ingestion:** The ingestion of the oil by the seabirds and sea mammals causes Kidney Failure, dehydration and other metabolic disorders.
- ✓ **Furs:** The furs of the sea otters and other marine animals are affected in several ways.
- ✓ **Photosynthesis:** The oil floats on the top of the water and this reduces the penetration of sunlight in the sea water.

Recovery

The Recovery from the oil spill is difficult and depends upon many factors. The clearing and recovery depends upon the following factors:

1. Type of the oil spilled
2. Temperature of the water which may affect the evaporation and biodegradation.
3. Type of shore line involved.

The most important methods are discussed here:

Bioremediation

Bioremediation **uses the microorganisms** or **biological agents** such as oil eating bacteria. There are three kinds of oil-consuming bacteria.

1. Sulfate-reducing bacteria (SRB)
2. Acid-producing bacteria are anaerobic
3. General aerobic bacteria (GAB)

Out of them, Sulfate-reducing bacteria (SRB) and acid-producing bacteria are anaerobic, while general aerobic bacteria (GAB) are aerobic.

Oil Zapper

The new technique of using the bacteria to get rid of oil spill has been called "Oil Zapping". Oil Zapping is a bio-remediation technique involving the use of 'oil zapping' bacteria. It was recently employed to clean up the Mumbai shoreline affected by the oil spill that occurred in August 2010.

The Mumbai Oil Spill happened when a merchant vessel M V Khalijia collided with a cargo ship MSC Chitra 10 km off the coast of Mumbai. MSC Chitra tilted 15 degrees soon after the collision but there was no loss of life.

The cargo ship eventually tilted to about 80 degrees dropping around 250 containers into the sea. Before the spill could be plugged 400 tons of oil had leaked into the sea.

The Maharashtra Pollution Control Board used the services of **The Energy and Resources Institute (TERI)** which has developed the oil zapping bacteria. TERI had developed this technique over a period of seven years.

The Oil Zapping project was **supported by** the Department of Biotechnology (Government of India) and the Ministry of Science and Technology.

How does Oil Zapper Work?

There are **five different bacterial strains** that are immobilized and mixed with a carrier material such as powdered corncob. This **mixture of five bacteria is called Oil Zapper**. Oilzapper feeds on hydrocarbon compounds present in crude oil and the hazardous hydrocarbon waste generated by oil refineries, known as Oil Sludge and **converts them into harmless CO₂ and water**. The Oilzapper is neatly packed into sterile polythene bags and sealed aseptically for safe transport. The shelf life of the product is three months at ambient temperature.

The technique was used successfully and 130,000 tons of oily sludge/ oil contaminated soil was treated as per the leading news sources.

Largest Oil Spills

As per records, **Kuwaiti oil fires of 1991** is the largest Oil spill of the world till date. It included 14-20 crore tons of crude oil. The top largest oil spills are as follows:

1. Kuwaiti oil fires 1991
2. Lakeview Gusher 1910-1911
3. Gulf War oil spill 1991
4. Deepwater Horizon 2010
5. Ixtoc I, Mexico Oil Spill of 1979

United Nations Convention on the Law of the Sea (UNCLOS)

United Nations Convention on the Law of the Sea (UNCLOS) is also known as **Law of the Sea treaty**. The **latest** UNCLOS is **UNCLOS III** which covers all the vital issues regarding the maritime boundaries. This convention introduced a number of provisions and covered the most significant issues such as **setting limits, navigation, archipelagic status and transit regimes**, exclusive economic zones (**EEZs**), continental shelf jurisdiction, deep seabed mining, the exploitation regime, protection of the marine environment, scientific research, and settlement of disputes. This treaty defines the following terms:

✓ **Internal waters:**

Internal Waters refers to the all water and waterways on the landward side of the baseline of a country. In the internal waters a country is free to set laws, regulate its use and use of its resources. There is **no interference of the foreign countries**.

✓ **Territorial waters :**

Territorial waters refer to **12 Nautical Miles** from the baseline. In this area the countries are free to set laws, regulate use and also use its resources. However, the **foreign vessels are NOT given all rights to passage through except "Innocent Passage"**.

The innocent passage refers to the passing through the waters which is **not prejudicial to peace and security**. However, the nations have right to suspend the innocent passage. The submarine while passing through other country's territorial waters has to navigate on the surface and show their flags.

✓ **Archipelagic waters :**

If the country is an archipelago or has an archipelago under it, a baseline is drawn between the outermost points of the islands, provided that these islands are close to each other. All **water inside** this is called Archipelagic Waters. The **state has full sovereignty** over these waters very much **similar to the internal waters** and the foreign vessels are **allowed for innocent passage** through archipelagic waters.

✓ **Contiguous zone :**

The contiguous zone refers to the area **12 Nautical Miles beyond the Territorial waters**. **This means that it is 24 Nautical Miles from the baseline limit**. In this zone the country can **enforce laws only in 4 areas viz. pollution, taxation, customs, and immigration**.

✓ **Exclusive Economic Zones (EEZs)**

Exclusive Economic Zones refers to the area from the edge of the territorial sea out to **200 nautical miles** from the baseline. In this area, the country has sole exploitation rights over all natural resources. The most important reason to introduce EEZ was to halt the clashes over the **Fishing Rights** and **Oil Rights**. In the EEZ, the foreign vessels have **freedom of navigation and over flight, subject to the regulation of the coastal states**. Foreign states are allowed to lay submarine pipes and cables.

UNCLOS and problem of Arctic

As per the current international law, **no country owns** the North Pole or the region of the Arctic Ocean surrounding it.

✓ There are five countries that surround the Arctic viz. Russia, United States (Via Alaska), Canada, Norway & Denmark (Via Green Land).

✓ However they are limited to an Exclusive Economic Zone (EEZ) which refers to an area of 200 Nautical Miles (370 kilometers) adjacent to their coasts.

The dispute in Arctic Seas is between these 5 countries viz. Russia, United States, Canada, Norway & Denmark. The **UNCLOS** had given every country a **ten year period to make claims** to an extended continental shelf which, if approved, gives it exclusive rights to resources on or below the seabed in the vast circumpolar territories.

In this context, on October 15, 2010, the Russian scientists have opened a floating polar research station in the Chuckchi Sea at the margin of the Arctic Ocean. The name of the station is **Severny Polyus-38** and will be home to 15 researchers for a year. They will conduct polar studies and gather scientific evidence 'to reinforce Russia's claims to the Arctic'.

Marine Protected Area

The **Convention on Biological Diversity** defines the **"Marine and Coastal Protected Area"** as follows:

Any defined area within or adjacent to the marine environment, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings.

- ✓ As of 2010, there are more than 5,000 MPAs, encompassing 0.8% of the ocean's surface
- Traditionally, the Marine Protected areas have been established by individual nations. The World Summit on Sustainable Development in 2002 called for the establishment of marine protected areas consistent with international laws and based on scientific information, including representative networks by 2012.
- The Evian Agreement of 2003 (among G-8 nations) and Durban Action Plan 2003 calls for regional action and targets to establish a network of protected areas by 2010 within the jurisdiction of regional environmental protocols. There were calls for establishing protected areas for 20 to 30% of the world's oceans by the goal date of 2012.

India and Marine Protected Areas

India has around 8,000 kms of coastline with two island systems, viz, the Andaman & Nicobar and Lakshadweep, and 2,305,143 Sq. Kms of Exclusive Economic Zone (EEZ). The marine and coastal environment of India harbours a host of resident and migratory wildlife. The important species found in the Indian waters include, Dugongs, Whales, Dolphins, Olive Ridley Turtles, a variety of fishes including the Whale Sharks & other sharks, Giant Groupers, Sea cucumbers, horseshoe crabs, sea shells, soft & hard corals, etc.

India has at present 5 designated Marine Protected Areas as follows:

1. Gulf of Mannar National Park, Tamil Nadu
2. Gulf of Kutch Marine National Park, Gujarat
3. Gulf of Kutch Marine Sanctuary, Gujarat,
4. Mahatma Gandhi Marine National Park, Andaman & Nicobar Islands
5. Gahirmatha Sanctuary, Orissa.

India has only five marine Protected Areas. Comparing to the marine diversity, is it too less and there is a greater need to have more marine Protected Areas in the country with well-developed management plans. Since, most of the marine species are migratory and not confined to one area only, management plans have to be based on large areas, rather than confining them to a Protected Area.

International Convention for the Regulation of Whaling

International Convention for the Regulation of Whaling is an international environmental agreement which governs the commercial, scientific, and aboriginal subsistence whaling practices of fifty-nine member nations. It was signed in 1946.

- ✓ By this convention, **International Whaling Commission (IWC)** was set up to "provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry".
- ✓ This organization has been active against the commercial whaling.
- ✓ In 1986, it adopted a moratorium on commercial whaling. This ban still continues.
- ✓ In 1994, it created the **Southern Ocean Whale Sanctuary surrounding** the continent of Antarctica. Here, the IWC has banned all types of commercial whaling.

- ✓ **Only two such sanctuaries have been designated by IWC till date.** Another is **Indian Ocean Whale Sanctuary** by the tiny island nation of the **Seychelles**.

Wadden Sea Agreement

Wadden Sea is located between the coast of northwestern continental Europe and the range of Frisian Islands. It is a World Heritage site (Dutch and German part) which forms a shallow body of water with tidal flats and wetlands, thus very rich in biodiversity. Wadden Sea is famous for its rich flora and fauna, especially birds such as waders (shorebirds), ducks, and geese. Wadden Sea is protected in cooperation of all three national parks, and cooperation between three countries as follows:

1. Schleswig-Holstein Wadden Sea National Park
2. Hamburg Wadden Sea National Park
3. Lower Saxony Wadden Sea National Park

The three countries viz. **Netherlands, Germany and Denmark** concluded the Wadden Sea Agreement for protection of the Wadden Sea in 1990.

ACCOBAMS

ACCOBAMS refers to "Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area". So, it is a cooperation **for the protection of Cetaceans** in the Black Sea and Mediterranean Sea. It was concluded on the sidelines of Convention on the Conservation of Migratory Species of Wild Animals, in **1996** and came into force in **2001**. Currently **21 countries** in the Black Sea, Mediterranean Sea and contiguous Atlantic area are parties to this convention.

MARPOL 73/78

MARPOL refers to Marine Pollution. MARPOL 73/78 is the International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. It entered into force on 2 October 1983 and it has 169 parties. It is one of the **most important environment** conventions on marine pollution and prevents the pollution from Oil Spill, Noxious Liquid Substances carried in Bulk, Harmful Substances carried in Packaged Form, Sewage, Garbage and Air Pollution.

It centers around minimizing the pollution of the seas, including dumping, oil and exhaust pollution. There are 150 countries party to this agreement.

India & MARPOL 73/78

India is a party to MARPOL 73/78. India's enshrined the obligation to inform contravention of provision of MARPOL 73/78 in the Sec 356 (H) of Merchant Shipping Act 1948.

- ✓ India's **Deepak class tankers** of the Indian Navy are fleet replenishment ships with two vessels INS Deepak and INS Shakti.
- ✓ Out of them **INS Shakti provides a greater safety against the accidental oil spillages in accordance with the latest MARPOL regulations.**
- ✓ INS Shakti has been launched on October 12, 2010 at Italy's Sestri Ponente shipyard of Fincantieri at Genoa.
- ✓ Both these Deepak class tankers are to be built in Italy under a Euro 300 deal with India. INS Deepak is at advanced stage of development right now.