Ecology '**Oikos**' meaning home or place to live in and '**logos**' meaning study. Literally it is the study of the home of nature. Capacity of ecosystem of self regulation is known as **homeostasis.**

Ecotone is a zone of junction between two or more diverse ecosystems. It has the conditions intermediate to the adjacent ecosystems. Hence it is a **zone of tension**. Sometimes the number of species and the population density of some of the species is much greater in this zone than either community. This is called **edge effect**.

A **niche** is the unique functional role or place of a species in an ecosystem. It is a description of all the biological, physical and chemical factors that a species needs to survive, stay healthy and reproduce. A niche is unique for a species.

Aquatic Zones

Aquatic systems are not called biomes. The major differences between the various aquatic zones are due to salinity, levels of dissolved nutrients, water temperature, depth of sunlight penetration.

The Distinction between these two food chains is the source of energy for the first level consumers. **In the grazing food chain the primary source of energy is living plant biomass while in the detritus food chain the source of energy is dead organic matter or detritus.** The two food chains are linked. The initial energy source for detritus food chain is the waste materials and dead organic matter from the grazing food chain.

The ecological Pyramids are of three categories.
1. Pyramid of numbers, 2. Pyramid of biomass, 3. Pyramid of energy or productivity.

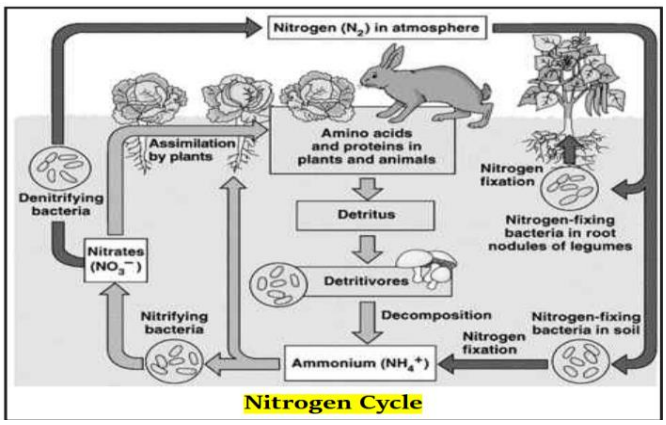
Bioaccumulation refers to how pollutants enter a food chain. In bioaccumulation there is an increase in concentration of a pollutant from the environment to the first organism in a food chain.

Biomagnification refers to the tendency of pollutants to concentrate as they move from one trophic level to the next. In order for biomagnification to occur, the pollutant must be : long-lived, mobile, soluble in fats, biologically active .

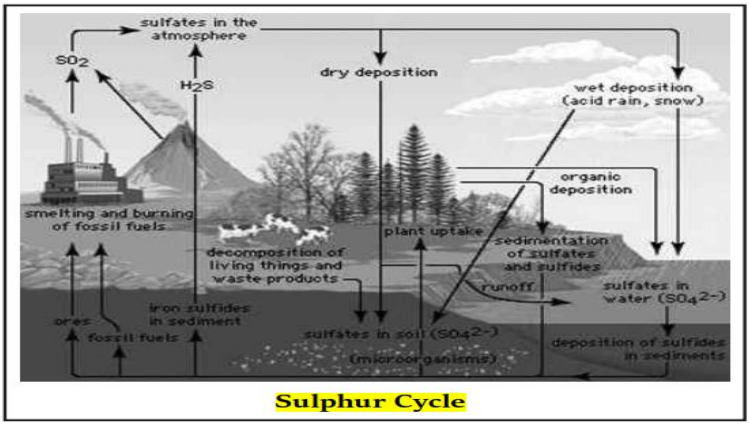
Carbon, hydrogen, oxygen, nitrogen and phosphorus as elements and compounds make up 97% of the mass of our bodies and are more than 95% of the mass of all living organisms.

Types of Nutrient Cycle

- Based on the nature of the reservoir, there are two types of cycles namely Gaseous and sedimentary cycle
- **Gaseous Cycle** – where the reservoir is the atmosphere or the hydrosphere, and
- **Sedimentary Cycle** – where the reservoir is the earth's crust



Nitrogen Cycle



Sulphur Cycle

Nitrogen fixation on earth is accomplished in three different ways:
(i) By microorganisms (bacteria and blue-green algae)
(ii) By man using industrial processes (fertilizer factories)
(iii) To a limited extent by atmospheric phenomenon such as thunder and lighting

The amount of Nitrogen fixed by man through industrial process has far exceeded the amount fixed by the Natural Cycle. As a result Nitrogen has become a pollutant which can disrupt the balance of nitrogen. It may lead to Acid rain, Eutrophication and Harmful Algal Blooms.

Phosphorus Cycle

Phosphorus occurs in large amounts as mineral in phosphate rocks and enters the cycle from erosion and mining activities. This is the nutrient considered to be main cause of excessive growth of rooted and free-floating microscopic plants in lakes.

In the ocean once the phosphorus accumulates on continental shelves in the form of insoluble deposits. After millions of years, the crustal plates rise from the sea floor and expose the phosphates on land. After more time, weathering will release them from rock and the cycle's geochemical phase begins again.

Sulphur Cycle

The sulphur reservoir is in the soil and sediments where it is locked in organic (coal, oil and peat) and inorganic deposits (pyrite rock and sulphur rock) in the form of sulphates, sulphides and organic sulphur. The sulphur cycle is mostly sedimentary except two of its compounds hydrogen sulphide (H_2S) and sulphur dioxide (SO_2) add a gaseous component to its normal sedimentary cycle.

Sulphur enters the atmosphere from several sources like volcanic eruptions, combustion of fossil fuels, from surface of ocean and from gases released by decomposition. Atmospheric hydrogen sulphide also gets oxidised into sulphur dioxide. Atmospheric sulphur dioxide is carried back to the earth after being dissolved in rainwater as weak sulphuric acid.

GRASSLAND ECOSYTEM

- are found where rainfall is about 25-75 cm per year, not enough to support a forest, but more than that of a true desert.
- Typical grasslands are vegetation formations that are generally found in temperate climates. In India, they are found mainly in the high Himalayas. The rest of India's grasslands are mainly composed of steppes and savannas.
- The major difference between steppes and savannas is that all the forage in the steppe is provided only during the brief wet season whereas in the savannas forage is largely from grasses that not only grow during the wet season but also from the smaller amount of regrowth in the dry season.
- Steppe formations occupy large areas of sandy and saline soil; in western Rajasthan, where the climate is semi-arid, average rainfall is less than 200 mm a year with a dry season of 10 to 11 months, and a large variation in rainfall. The soil is always exposed, sometimes rocky but more often sandy with fixed or mobile dunes. Forage is available only during the brief wet season. The grass layer is sparse and consists mainly of annual grass species.

- In the central and eastern parts of Rajasthan, where the rainfall is about 500 mm per year and the dry season is of 6-8 months, dry savanna grazing ecosystems have developed. The light shade cast by the sparse population of trees like khetri favours the growth of the grasses.

Grassland types of India

Types of Grasslands

1) **Semi-arid zone**
   It covers the northern portion of Gujarat, Rajasthan (excluding Aravallis), western Uttar Pradesh, Delhi and Punjab. The topography is broken up by hill spurs and sand dunes.
2) **Dry sub humid zone**
   It covers the whole of peninsular India (except Nilgiri).

3) **Moist sub humid zone**
It covers the Ganga alluvial plain in Northern India. The topography is level, low lying and ill-drained.

4) **Humid montane regions**
This extends to the humid montane regions and moist sub-humid areas of Assam, Manipur, West Bengal, Uttar Pradesh, Punjab, Himachal Pradesh and Jammu and Kashmir. The savanna is derived from the humid forests on account of shifting cultivation and sheep grazing.

Only about 13 million hectares in the country are classified as permanent grazing lands. On top of it, they exist in a highly degraded state. Due to absence of humus cover, mineral soil surface is heavily trampled, when wet it produces puddling of the surface layer. In turn it reduces the infiltration of water into the soil and accelerates run off, resulting in soft erosion.

Under moist conditions fire favours grass over trees, whereas in dry conditions fire is often necessary to maintain grasslands against the invasion of desert shrubs. Burning increases the forage yields.

DESERT ECOSYSTEM Lack of rain in the mid latitude is often due to stable high pressure zones; deserts in temperate regions often lie in "rain shadows", that is, where high mountains block off moisture from the seas.

Flora consists of two types:

depending directly upon on the rain

- The ephernerals are delicate annuals, apparently free from any xerophilous adaptations, having slender stems and root-systems and often large flowers. They appear almost immediately after rain, develop flowers and fruits in an incredibly short time, and die as soon as the surface layer of the soil dries up.
- The rain perennials are visible above the ground only during the rainy season, but have a perennial underground stem.

depending on the presence of subterranean water

- are capable of absorbing water from deep below the surface of the ground by means of a well-developed root system, the main part of which generally consists of a slender, woody tap root of extraordinary length.
- Generally, various other xerophilous adaptations are resorted to such as reduced leaves, thick hairy growth, succulence, coatings of wax, thick cuticle, protected stomata, etc., all having for their object of reduction of transpiration.

Cold Desert/ Temperate Desert

- insignificant monsoon - Mean annual rainfall less than 400mm
- Soil type - sandy to sandy loam ; Soil pH - neutral to slight alkaline; Soil nutrient - Poor organic matter content
- Soil has low water retention capacity, Wind erosion is more common.

Status of Indian desertification

As per the **Desertification and Land Degradation Atlas of India, 2007**, the percentage of country under dry lands is 69.6%. The total area undergoing the process of land degradation in India is 105.48 million hectares, which constitutes 32.07% of India's total land area. 81.45 million hectares area of the country is under desertification (land degradation within drylands).

Control measures

India is a signatory to United Nations Convention to Combat Desertification (UNCCD). The National Action Programme for combating desertification was prepared in 2001 to take appropriate action in addressing the problems of desertification. Some of the major programmes currently implemented that address issues related to land degradation and desertification are

- Integrated Watershed Management Programme
- National Afforestation Programme
- National Mission for Green India
- The Mahatma Gandhi National Rural Employment Guarantee Scheme
- Soil Conservation in the Catchment of River Valley Project and Flood Prone River
- National Watershed Development Project for Rainfed Areas
- Desert Development Programme

- Fodder and Feed Development Scheme-component of Grassland Development including Grass Reserves, Command Area Development and Water Management programme etc.

INDIAN STATE OF FOREST REPORT, 2017

- State of Forests Report is published by the Forest Survey of India (FSI) on a biennial basis since 1987.
- The India State of Forest Report 2017 is the 15th report in the series. It is based on interpretation of LISS III sensor data of indigenous Resourcesat – II satellite. The satellite data interpretation is followed by extensive and rigorous ground truthing.
- The total forest and tree cover is 24.39 percent of the total geographical area. Forest and Tree Cover of the country has increased by 8,021 sq km (1 %) as compared to the assessment of 2015. The very dense forest (VDF) has increased by 1.36 % as compared to the last assessment. VDF absorbs maximum carbon dioxide from the atmosphere.
- Madhya Pradesh has the largest forest cover in the country, followed by Arunachal Pradesh and Chhattisgarh. Mizoram, with 88.93% of forest cover has the highest forest cover in percentage terms, followed by Lakshadweep with 84.56 per cent. The ISFR 2015 states that 15 States/Union Territories have above 33% of the geographical area under forest cover.
- Out of these, 7 States/Union Territories – Mizoram, Lakshadweep, Andaman & Nicobar Island, Arunachal Pradesh, Nagaland, Meghalaya and Manipur have more than 75% forest cover, while 8 states – Tripura, Goa, Sikkim, Kerala, Uttarakhand, Dadra & Nagar Haveli, Chhattisgarh and Assam have forest cover is between 33-75%.
- "India is ranked 10th in the world in forest cover, with 24.39% of land area under forest and tree cover.
- As per the FAO report, India is placed 8th in the list of Top10 nations reporting greatest annual net gain in the forest area.

(i) **Fresh water ecosystems- <5 ppt** i.e, lakes, ponds, pools, springs, streams, and rivers
(ii) **Marine ecosystems - >35 ppt** i.e, shallow seas and open ocean
(iii) **Brackish water ecosystems – 5 < ppt <35** i.e, estuaries, salt marshes, mangrove swamps and forests.

Dissolved oxygen:

- In fresh water the average concentration of dissolved oxygen is 10 ppm, which is 150 times lower than the concentration of oxygen in an equivalent volume of air.
- Oxygen is less soluble in warm water. Warm water also enhances decomposer activity. Therefore, increasing the temperature of a waterbody increases the rate at which oxygen is depleted from water.
- When the dissolved oxygen level falls below 3-5 ppm, many aquatic organisms are likely to die.

Lakes In India

- Lake 'Sudarshan' in Gujarat's Girnar area was perhaps the oldest man-made lake in India, dating back to 300 BC.
- Based on the levels of salinity, they are known as Freshwater, Brackish or Saline lakes
- On the basis of their nutrient content, they are categorized as Oligotrophic (very low nutrients), Mesotrophic (moderate nutrients) and Eutrophic (highly nutrient rich).
- Vast majority of lakes in India are either eutrophic or mesotrophic because of the nutrients derived from their surroundings or organic wastes entering them.

Removal of the nutrients from a lake

- Flushing with nutrient-poor waters and Deep water abstraction.
- On-site P-elimination by flocculation/flotation with water backflow, or floating Plant NESSIE with adsorbents.
- On-site algae removal by filters and P-adsorbers. On-site algae skimming and separator thickening.
- Artificial mixing / Destratification (permanent or intermittent).
- Harvest of fishes and macrophytes and Sludge removal.

Ameenpur Lake - First Biodiversity Heritage Site under the biodiversity act, 2002. It is an ancient man-made lake in a western part of Telangana. Biodiversity Heritage sites are managed by a locally constituted Biodiversity Management Committee and get funding for its protection.

EUTROPHICATION (Greek word – 'Eutrophia' means adequate & healthy nutrition)

- Eutrophication is a syndrome of ecosystem, response to the addition of artificial or natural nutrients such as nitrates and phosphates through fertilizer, sewage, etc that fertilize the aquatic ecosystem.
- It is primarily caused by the leaching of phosphate and/or nitrate containing fertilisers from agricultural lands into lakes.
- As Algal Bloom covers the surface layer, it restricts the penetration of sunlight and Diffusion of gas from atom.
- The oxygen level is already low because of the population explosion and further oxygen is taken up by microorganisms which feed off the dead algae during decomposition process.
- Anaerobic conditions can promote growth of bacteria which produces toxins deadly to aquatic organisms, birds, mammals.

Toxicity

- Some algal blooms when die or eaten, release neuro & hepatotoxins which can kill aquatic organism & pose threat to humans. (e.g) Shellfish poisoning.
- Depletion of dissolved oxygen level and Increased incidences of fish kills & loss of desirable fish species & reduction in harvesting. Loss of coral reefs.
- Decrease in water transparency and increased turbidity which affects navigation
- Increased biomass of inedible toxic phytoplankton and Increase in bloom of gelatinous zooplankton
- Increased biomass of benthic and epiphytic algae
- Unsuitable for aesthetic recreation, and reduction in value of water body

Mitigation

- Riparian buffer. Interfaces between a flowing body of water and land created near the waterways, farms, roads, etc. in an attempt to filter pollution.
- Sediments and nutrients are deposited in the buffer zones instead of deposition in water.
- Minimizing the non-point pollution , Nitrogen testing & modeling
- **N-Testing** is a technique to find the optimum amount of fertilizer required for crop plants. It will reduce the amount of nitrogen lost to the surrounding area.
- Treatment of Industrial effluents and Organic farming & Integrated Farming System.
- Reduction in livestock densities, Improving the efficiency of use of fertilizer and Treatment of runoff from street & storm drains
- Reduction in nitrogen emission from vehicles and power plants

India's Wetlands

- support millions of people directly and indirectly, protect from storms, flood control, improve water quality, supply food, fiber and raw materials.
- India has totally 27,403 wetlands, of which 23,444 are inland wetlands and 3,959 are coastal wetlands. Wetlands occupy 18.4% of the country's area of which 70% are under paddy cultivation.
- Natural wetlands in India range from high altitude wetlands in Himalayas; flood plains of the major river systems; saline and temporary wetlands of the arid and semi-arid regions; coastal wetlands such as lagoons, backwaters, estuaries, mangroves, swamps and coral reefs, and so on.

National Wetlands Conservation Programme (NWCP) {1985-86}

- Under the programme, 115 wetlands have been identified by the Ministry which require urgent conservation and management interventions.
- The Central Government is responsible for overall coordination at the international and national levels. It also provides guidelines, financial & technical assistance to state govt.
- Since the land resources belong to them, the State Governments/UT Administration are responsible for management of wetlands and implementation of the NWCP for ensuring their wise-use.

Criteria for Identification of Wetlands of National Importance under NWCP are same as those prescribed under the **'Ramsar Convention on Wetlands'** and are as given below:

- ***Sites containing representative, rare or unique wetland types***

(i) If it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

- ***Criteria based on species and ecological communities***

(ii) If it supports vulnerable, endangered, or critically endangered species; or threatened ecological communities.
(iii) If it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
(iv) If it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

- ***Specific criteria based on water birds***

(v) If it regularly supports 20,000 or more water birds.
(vi) If it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds.

- ***Specific criteria based on fish***

(vii) If it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
(viii) If it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend. Specific criteria based on water/life and culture.

(ix) If it is an important source of food and water resource, increased possibilities for recreation and eco-tourism, improved scenic values, educational opportunities, conservation of cultural heritage (historic or religious sites).

Montreux Record under the Ramsar Convention, is a register of the **List of Wetlands of International Importance**. It highlights those sites where adverse changes in ecological character have occurred, are occurring, or are likely to occur as a result of technological developments, pollution or other human interference and which are therefore in need of priority conservation attention. It is used to identify priority sites for positive national and international conservation attention. Sites may be added to and removed from the Record only with the approval of the Contracting Parties in which they lie.

Montreux Record sites in India

1. **Chilika lake, Orissa** was placed on the Montreux Record in 1993 due to siltation, which was choking the mouth of the lake. Following the rehabilitation efforts of the government, it was removed from the Record in 2002.
   For this achievement, the Chilika Development Authority received the Ramsar Wetland Conservation Award for 2002.

2. **Loktak lake, Manipur** was included on the Montreux Record in 1993 (signifying habitat degradation), as a result of ecological problems such as deforestation in the catchment area, infestation of water hyacinth and pollution. The construction a hydroelectric power plant has caused the local extinction of several native fish species.

3. **Keoladeo national park, Rajasthan** was placed on the Montreux Record in 1990 due to water shortage and unbalanced grazing regime around it. The invasive growth of the grass Paspalum distichum has changed the ecological character of large areas of the site, reducing its suitability for certain waterbird species, notably the Siberian crane.

Neknampur Lake - First FTW Lake

Floating treatment wetland works on the basis of ***hydroponics technique***. Hydroponics permits plants to grow on the water with the help of sunlight (no need of soil). A floating island unit is essentially a platform designed using styrofoam, bamboo, gunny bags and coirand it performs the function of a wetland.

ESTUARY ECOSYSTEM

- Estuaries are water bodies where the flow of freshwater from river mixes with salt water transported, by tide, from the ocean. The complete salinity range from 0-35 ppt is seen from the head (river end) to the mouth (sea end) of an estuary.
- It is the most productive region as it receives the high amount of nutrients from fresh and marine water.
- Estuaries are most heavily populated areas throughout the world, with about 60% of the world's population living along

estuaries and the coast. Coastal lakes which have their connection with the sea through small openings are better known as ***lagoons or backwaters***.

India Estuarine Ecosystem

- The Country has 14 major, 44 medium and 162 minor rivers drains into the sea through various estuaries.
- Most of the India's major estuaries occur on the east coast (Bay of Bengal). The estuaries on the west coast are smaller.

MANGROVES are the characteristic littoral plant formation of tropical and subtropical sheltered coastlines. They are basically evergreen land plants growing on sheltered shores, typically on tidal flats, deltas, estuaries, bays, creeks and the barrier islands.

Mangrove profile in India

- **The mangroves of Sundarbans** are the largest single block of tidal holophytic mangroves of the world. This mangrove forest is famous for the Royal Bengal Tiger and crocodiles. Mangrove areas are being cleared for agricultural use.
- The **mangroves of Bhitarkanika (Orissa)**, which is the second largest in the Indian sub continent, harbour high concentration of typical mangrove species and high genetic diversity.
- Mangrove swamps occur in profusion in the intertidal mudflats on both side of the creeks in the **Godavari-Krishna deltaic regions of Andhra Pradesh.**
- **Mangroves of Pichavaram and Vedaranyam** are degraded mainly due to construction of aquaculture ponds and salt pans.
- On the west coast of India, mangroves, mostly scrubby and degraded occur along the **intertidal region of estuaries and creeks in Maharashtra, Goa and Karnataka.**
- The mangrove vegetation in the **coastal zone of Kerala** is very sparse and thin.
- In Gujarat (north-west coast) mangroves Avicennia marine, Avicennia officinalis and Rhizophora mucronate are found mainly in **Gulf of Kachchh and the Kori creek**.
- Mangroves are of scrubby type with stunted growth, forming narrow, discontinuous patches on soft clayey mud.
- In size, mangroves range from bushy stands of dwarf mangroves found in Gulf of Kuchchh, to taller stands found in the Sunderbans.
- On the **Andaman & Nicobar Islands**, the small tidal estuaries, neritic inlets and the lagoons support a dense and diverse undisturbed mangrove flora.

Fine, anoxic sediments deposited under mangroves act as sinks for a variety of heavy (trace) metals which are scavenged from the overlying seawater by colloidal particles in the sediments. By cleaning our air, they taking in carbon dioxide, storing the carbon in their roots, leaves, branches and in its surrounding silt, and release oxygen back to the atmosphere, along with a little methane gas.

CORAL REEFS

- **Coral has a symbiotic relationship with 'zooxanthellae' microscopic algae** which live on coral [which is closer to the ocean surface and so that the algae gets adequate light]. Zooxanthellae assist the coral in nutrient production through its photosynthetic activities. These activities provide the coral with fixed carbon compounds for energy, enhance calcification ,and mediate elemental nutrient flux.
- The tissues of corals themselves are actually not the beautiful colors of the coral reef, but are instead clear (white). The corals receive their coloration from the zooxanthellae living within their tissues.
- There are two types of corals: hard corals and soft corals, such as sea fans and gorgonians. Only hard corals build reefs.
- The host coral polyp in return provides its zooxanthellae with a protected environment to live within, and a steady supply of carbon dioxide for its photosynthetic processes.
- The builders of coral reefs are tiny animals called polyps. As these polyps thrive, grow, then die, they leave their CaCo3 skeletons behind. The limestone is colonized by new polyps. Therefore, a coral reef is built up of layers of these skeletons covered ultimately by living polyps.
- Majority of coral reefs are found in tropical and sub-tropical water, there are also deep water corals in colder regions.

Indian Mangrove Profile

4.7.3. Role of mangroves

- Mangrove plants have (additional) special roots such as prop roots, pneumatophores which help to impede water flow and thereby enhance the deposition of sediment in areas (where it is already occurring), stabilize the coastal shores, provide breeding ground for fishes.
- Mangroves moderate monsoonal tidal floods and reduce inundation of coastal lowlands.
- It prevents coastal soil erosion.
- It protects coastal lands from tsunami, hurricanes and floods.
- Mangroves enhance natural recycling of nutrients.
- Mangrove supports numerous flora, avifauna and wild life.
- Provide a safe and favorable environment for breeding, spawning, rearing of several fishes.
- It protects coastal inland from adverse climatic elements.
- It supplies woods, fire wood, medicinal plants and edible plants to local people.
- It provides numerous employment opportunities to local communities and augments their livelihood.

- Cold-water corals inhabit deep, cold (39-55 degrees F), water. ***The United Nations Environment Programme reports that there are more cold-water coral reefs worldwide than tropical reefs***.

Features

- They occur in shallow tropical areas where the sea water is clean, clear and warm.
- The coral reef cover in Indian waters is roughly estimated upto 19,000 sq. Km.
- The corals are generally slow growing colonies of animals while zooxanthellae are fast growing plants.
- Even though corals live in nutrient poor waters, their capability to recycle the scarce nutrients is enormous.
- In coral reef ecosystem, many invertebrates, vertebrates, and plants live in close association to the corals, with tight resource coupling and recycling, allowing coral reefs to have extremely high productivity and biodiversity, such that they are referred to as '**the Tropical Rainforests of the Oceans'**.

Threat

1. **Natural causes** may be due to the outbreak of reef destroying mechanisms, "bleaching" and depletion of essential symbiotants.
2. **Anthropogenic causes** – may be due to chemical pollution (pesticides, cosmetics, etc), industrial pollution, mechanical damage, nutrient loading or sediment loading, Dredging, shipping, tourism, mining or collection, thermal pollution, intensive fishimg,etc.

- Recent accelerated coral reef decline seems to be related mostly to anthropogenic impacts (overexploitation, overfishing, increased sedimentation and nutrient overloading. Natural disturbances which cause damage to coral reefs include violent storms, flooding, high and low temperature extremes, El Nino Southern Oscillation (ENSO) events, subaerial exposures, predatory outbreaks and epizootics.
- Coral reef bleaching is a common stress response of corals to many of the various disturbances mentioned above.

Coral Bleaching

- Bleaching, or the paling of coral colour occurs when

(i) the densities of zooxanthellae decline and / or
(ii) the concentration of photosynthetic pigments within the zooxanthellae fall.

- When corals bleach they commonly lose 60-90% of their zooxanthellae and each zooxanthella may lose 50-80% of its photosynthetic pigments.

- If the stress-causing bleaching is not too severe and if it decreases in time, the affected corals usually regain their symbiotic algae within several weeks or a few months.
- High temperature and irradiance stressors have been implicated in the disruption of enzyme systems in zooxanthellae that offer protection against oxygen toxicity.
- Photosynthesis pathways in zooxanthellae are impaired at temperatures above 30 degrees C, this effect could activate the disassociation of coral / algal symbiosis.
- Low- or high-temperature shocks results in zooxanthellae low as a result of cell adhesion dysfunction.

GOVERNMENT MEASURES TO PROTECT MANGROVE FOREST AND COASTAL ECOSYSTEM

- Under the regulatory measures, the **Coastal Regulation Zone (CRZ) Notification (2011)** and the **Island Protection Zone (IPZ) Notification 2011** regulates the development activities along the Sea coast and tidal influenced water bodies.
- The mangroves and coral reefs areas are categorized as ecological sensitive areas (CRZ-I) where no new constructions are permitted except projects relating to Department of Atomic Energy; pipelines, conveying systems including transmission lines; installation of weather radar for monitoring of cyclones movement and prediction by Indian Meteorological Department and construction of trans harbour sea link and without affecting the tidal flow of water.
- To enforce and implement the CRZ and IPZ Notifications, the Ministry of Environment and Forests has constituted the National and State/UT level Coastal Zone Management Authorities.

The Ministry of Environment & Forests also provides financial assistance to Coastal States/Union Territories, who so request, under its Centrally Sponsored Scheme for conservation and management of mangroves and coral reef.

- In addition Coral reef is included in Schedule I of the Wild Life Protection Act, 1972 which affords it the highest degree of protection.
- Further Protected Areas, viz.***4 National Parks, 96 Sanctuaries and 3 Marine Biosphere Reserve*** have been created all over the country under the provisions of the **Wild Life (Protection) Act, 1972** to conserve marine life including coral reef.
- **The Wildlife Crime Control Bureau** has also been set up to strengthen the enforcement of law for control of poaching and illegal trade in wildlife and its products.

KEY INITIATIVES TO PROTECT MARINE AND COASTAL ENVIRONMENTS

Coastal Ocean Monitoring and Prediction System (COMAPS) {1991} Assesses the health of coastal waters and facilitates management of pollution-related issues. Programme was restructured and modified in 2000–2001 to include pollution monitoring; liaison, regulation and legislation; and consultancy services.

Land Ocean Interactions in the Coastal Zone (LOICZ) {1995} Investigates the effects of global change on the coastal zone. Aims to develop, on a scientific basis, the integrated management of coastal environments

Integrated Coastal and Marine Area Management (ICMAM) {1998} Aims at integrated management of coastal and marine areas. Model plans for Chennai, Goa and Gulf of Kutch being prepared

Society of Integrated Coastal Management (SICOM) {2010} Major national initiative to protect coastal ecosystems. A professional body with experts in various aspects of coastal science and management

Institutions for Coastal Management

- The **Notification on Coastal Regulation Zone (CRZ), 1991** aims at protecting coastal stretches in India.
- India has created institutional mechanisms such as **National Coastal Zone Management Authority (NCZMA)** and **State Coastal Zone Management Authority (SCZMA)** for enforcement and monitoring of the CRZ Notification.
- These authorities have been delegated powers under **Section 5 of the Environmental (Protection) Act, 1986** to take various measures for protecting and improving the quality of the coastal environment and preventing, abating and controlling environmental pollution in coastal areas

GANGA ACTION PLAN was launched on 14th January 1986 with the main objective of pollution abatement, to improve water quality by interception, diversion and treatment of domestic sewage and toxic and industrial chemical wastes present, from identified grossly polluting units entering in to the river.

After reviewing the effectiveness of the "Ganga Action Plan", the Government announced the "**Mission Clean Ganga**" project on 31st December, 2009 with the objective that by 2020, no municipal sewage and industrial waste would be released in the river without treatment, with the total budget of around Rs.15,000 crore. The Government also established the **National Ganga River Basin Authority (NGRBA)**, chaired by the Prime Minister, with the objective to ensure effective abatement of pollution and conservation of the river Ganga, by adopting a river basin approach for comprehensive planning and management.

NAMAMI GANGA PROGRAM has been proposed to be set up and a sum of Rs. 2,037 crores has been set aside for the purpose of conservation and improvement of the Ganga. In addition a sum of Rs. 100 crores has been allocated for developments of Ghats and beautification of River Fronts at Kedarnath, Haridwar, Kanpur, Varanasi, Allahabad, Patna and Delhi in the current financial year.

Accordingly, Namami Gange approaches Ganga Rejuvenation by consolidating the existing ongoing efforts and planning for a concrete action plan for future. The interventions at Ghats and River fronts will facilitate better citizen connect and set the tone for river centric urban planning process.

Following are proposed to be taken up under Namami Gange program:

1) Nirmal Dhara- ensuring sustainable municipal sewage management

- Project prioritization in coordination with Ministry of Urban Development.
- Incentive for states to take up projects on Ganga Main-stem by providing an additional share of central grants for sewerage infrastructure.
- Uniform standards for both MoUD scheme and Namami Gange programme, 10 years mandatory O&M by the same service provider at par with NGRBA programme and PPP, Mandatory reuse of treated water
- Expanding coverage of sewerage infrastructure in 118 urban habitations on banks of Ganga- estimated cost by MoUD is Rs 51000 Crores

2) **Nirmal Dhara- managing sewage from Rural Areas**

- Ministry of Drinking Water and Sanitation scheme for all Ganga bank Gram Panchayts (1632) free from open defecation by 2022, at a cost of Rs 1700 Crores as central share

3) **Nirmal Dhara- managing Industrial discharge**

- Making Zero Liquid Discharge mandatory
- Rationalized water tariff to encourage reuse
- Real time water quality monitoring

4) **Aviral Dhara**

- Enforcing River Regulatory Zones on Ganga Banks
- Rational agricultural practices, efficient irrigation methods
- Restoration and conservation of wetlands

5) Ensuring ecological rejuvenation by conservation of aquatic life and biodiversity

6) Promotion of Tourism and Shipping in a rational and sustainable manner

7) Knowledge Management on Ganga through Ganga Knowledge Centre leading to a Ganga University of River Sciences

NRI Ganga Fund will be set up which will finance special projects. NRI Ganga Fund could be setup under the aegis of **Ministry of Overseas Indian Affairs** or Ministry of Finance with focus on funds sourcing and corpus management.

CLEAN GANGA FUND Considering that there is a need to increase people's participation from across the country and abroad, it is proposed to set up a "Clean Ganga Fund (CGF)" with voluntary contributions.

- CGF will have the objective of contributing to the national effort of improving the cleanliness of the river Ganga with the contributions received from the residents of the country, NRIs/ PIO and others.

- CGF will be operated through a bank account by a Trust to be headed by the finance minister. The secretariat of the Trust will be set up in Ministry of Water Resources, River Development and Ganga Rejuvenation under the Mission Director, Clean Ganga.
- Domestic donors to the fund shall be eligible for tax benefits as in the case of "Swachch Bharat Kosh". Foreign donors could get suitable tax exemptions in domestic law, wherever permissible.
- CGF will explore the possibility of setting up daughter funds in other jurisdictions/countries of high donor interest such as USA, UK, Singapore, UAE, etc. to enable tax benefits to donors in their respective jurisdictions.
- CGF will be catalytic in nature and will identify and fund specific projects which could be pilot projects, R&D projects, innovative projects or other focused projects. The Fund will define specific and measurable objectives to form the basis for planning, funding, and evaluation.

Broad activities that will be financed from the Clean Ganga Fund (CGF) Fund are:

- Activities outlined under the 'Namami Gange' programme for cleaning of river Ganga.
- Control of non-point pollution from agricultural runoff, human defecation, cattle wallowing, etc.
- Setting up of waste treatment and disposal plants along the river around the cities.
- **Conservation** of the biotic diversity of the river. **Community** based activities to reduce polluting human interface with the river. **Development** of public amenities including activities such as Ghat redevelopment.
- R&D and innovative projects for new technology and processes for cleaning the river.
- Independent oversight through intensive monitoring and real time reporting.
- Any other activity as approved by the Trust

Fly Ash

- Ash is produced whenever combustion of solid material takes place.
- Fly ash is one such residue which rises with the gases into the atmosphere. It is a very fine powder and tends to travel far in the air. The ash which does not rise is termed as bottom ash.
- Nearly 73% of India's total installed power generation capacity is thermal, of which 90% is coal-based generation,

Environmental effects?

- If fly ash is not captured and disposed off properly, it can pollute air and water considerably. It causes respiratory problems.
- Fly ash in the air slowly settles on leaves and crops in fields in areas near to thermal power plants and lowers the plant yield.

Advantages:

- Cement can be replaced by fly ash upto 35%, thus reducing the cost of construction, making roads, etc. Fly ash bricks are light in weight and offer high strength and durability.
- Fly ash is a better fill material for road embankments and in concrete roads and in reclamation of wastelands.
- Abandoned mines can be filled up with fly ash. It can increase the crop yield and it also enhances water holding capacity of the land .

Policy measures of MoEF:

- MoEF vide its notification in 2009, has made it mandatory to use Fly Ash based products in all construction projects, road embankment works and low lying land filling works within 100 kms radius of Thermal Power Station.
- **To use Fly Ash in mine filling activities within 50 kms radius of Thermal Power Stations.**

Name Of Pollutant	Sources	Health Effects
Sulphur Oxides	Thermal power plants and industries	Eye and throat irritation, cough, allergies, impairs enzyme function in respiratory system. Reduces exchange of gases from lung surface.
Nitrogen Oxides	Thermal power plant, industries and vehicles	Irritation and inflammation of lungs, breathlessness, impairs enzyme function in respiratory system and causes bronchitis and asthma.
Suspended Particulate Matter (SOM)	Vehicular emissions and burning of fossil fuels	Lung irritation reduces development of RBC and cause pulmonary malfunctioning.
Carbon Monoxide	Vehicular emissions and burning of fossil fuels	Difficulty in breathing, severe headaches, irritation to mucous membrane, unconsciousness and death
Carbon Dioxide	Burning of fossil fuels	Impairs reflexes, judgment and vision, severe headaches and heart strain.
Smog	Industries and vehicular pollution	Respiratory problems and intense irritation to the eyes.
Ozone	Automobile emissions	Breathlessness, asthma, wheezing, chest pain, emphysema and chronic bronchitis.
Chlorofluorocarbons	Refrigerators, sprays, emissions from jets	Depletion of stratospheric ozone layer, global warming.
Hydrocarbons	Burning of fossil fuels	Carcinogenic effect on lungs, kidney damage, hypertension, respiratory distress, irritation of eyes, nose and throat, asthma, bronchitis and impairs enzyme function in respiratory system.
Tobacco Smoke	Cigarettes, cigars etc.	Chronic bronchitis, asthma and lung cancer, irritation of eyes, nose and throat.
Mercury	Industries	Nervous disorders, insomnia, memory loss, excitability, irritation, tremor, gingivitis and minamata disease.
Lead	Leaded petrol emissions	Damage to brain and central nervous system, kidneys and brains, impaired intelligence and interference with development of RBCs.
Asbestos dust	Asbestos mining, asbestos sheet manufacturing	Asbestosis which involves severe respiratory problems and may lead to cancer.
Radioactive pollutants	Cosmic rays, x-rays, beta rays, radon and radium	Destroy living tissues and blood cells; affect cell membrane and cell enzyme functions, leukemia, and permanent genetic changes.
Coal dust and particles	Coal mines	Black lung cancer, pulmonary fibrosis which lead to respiratory failure.
Cadmium	Industries	Affects the heart
Silica dust	Silicon quarries	Silicosis affects the lungs
Cotton dust	Cotton textile factories	Byssinosis involves destruction of lung tissues, chronic cough, bronchitis and emphysema.

Control Measures

1. Policy measures
2. Preventive measures:

- Selection of suitable fuel (e.g.fuel with low sulphur content) and its efficient utilization
- Modifications in industrial processes and/or equipments to reduce emission.
- Selection of suitable manufacturing site and zoning. e.g. setting of industries at a distance of residential areas, installation of tall chimneys.

Control measures:

(i) destroying the pollutants by thermal or catalytic combustion
(ii) conversion of the pollutants to a less toxic form
(iii) collection of the pollutant

a) Control of particulate matter: Two types of devices - arresters and scrubbers are used to remove particulate pollutants from air. These are arresters and scrubbers.
i. **Arresters**: These are used to separate particulate matters from contaminated air.
ii. **Scrubbers**: These are used to clean air for both dusts and gases by passing it through a dry or wet packing material.

b) Control of Gaseous Pollutants:
The gaseous pollutants can be controlled through the techniques of Combustion, absorption and adsorption.

c) Control of Automobile Exhaust
i. use of efficient engines (e.g. multipoint fuel injectionengine).
ii. Catalytic converter filters in the vehicles can convert nitrogen oxide to nitrogen and reduce the potential hazards of NOx.
iii. use of good quality automobile fuels
iv. use of lead free petrol.
v. Use of compressed natural gas (CNG).

Government Initiatives

(1) National Air Quality Monitoring Programme

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

(i) to determine status and trends of ambient air quality;
(ii) to ascertain the compliance of NAAQS;
(iii) to identify non-attainment cities;
(iv) to understand the natural process of cleaning in the atmosphere;
(v) to undertake preventive and corrective measures.

- Annual average concentration of SOx levels are within the prescribed National Ambient Air Quality Standards (NAAQS).
- This reduction from earlier levels is due to various measures taken, including the use of CNG in public transport in Delhi, the reduction of sulphur in diesel and use of LPG instead of coal as a domestic fuel.
- A mixed trend is observed in NO2 levels due to various measures taken for vehicular pollution control, such as stricter vehicular emission norms being partially offset by increased NOx levels due to the use of CNG in urban transport.

(2) National Ambient Air Quality Standards (NAAQS) were notified in the year 1982, duly revised in 1994 based on health criteria and land uses. The NAAQS have been revisited and revised in ***November 2009 for 12 pollutants***, **which include (SO_2), (NO_2), (PM10), (PM2.5), ozone, lead, CO, arsenic, nickel, benzene, ammonia, benzopyrene.**

(3) National Air Quality Index was launched by the Prime Minister in April, 2015 starting with 14 cities to disseminate air quality information. **The AQI has six categories of air quality, viz Good, Satisfactory, Moderately Polluted, Poor, Very Poor and Severe** with distinct colour scheme. Each of these categories is associated with likely health impacts.

AQI considers eight pollutants (PM10, PM 2.5, NO2, SO2, CO, O3, NH3 and Pb) for which (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed.

Air Pollution in India

- India's air pollution, ranked among the worst in the world is adversely impacting the lifespan of its citizens, reducing most Indian lives by over three years - **WHO**.
- Over half of India's population – 660 million people – live in areas where fine particulate matter pollution is above India's standards for what is considered safe - '**Economic & Political Weekly'**
- Of the world's top 20 polluted cities, 13 are in India. Air pollution slashes life expectancy by 3.2 years for the 660 million Indians who live in cities.
- 2014 global analysis of how nations tackle environmental challenges has ranked India 155 among 177 nations and labelled the country's air quality among the worst in the world.
- India is placed as the "bottom performer" on several indicators such as environmental health impact, air quality, water and sanitation and india's environment health severly lags behind the BRICS nations - **Environmental Performance Index 2014**.
- The Ganga and Yamuna are ranked among the world's 10 most polluted rivers.
- Despite the directives of the National Green Tribunal, civic agencies continue to allow concretisation in greenbelts. Mindless concretisation of ground and green belts and booming real estate has led to **heat island effect** - shortwave radiations emanate from concrete surfaces at night time. Concretisation prevents ground water recharge thus depleting green cover. Tall buildings

also block winds thereby reducing their cooling effect. Excessive concretisation also leads to weakening of trees.

- **Scientific innovation needs to be complemented by legislative change as well as by changes in social behaviour**

Effects of Water Pollution

1. Effects on aquatic ecosystem:

i) Polluted water reduces Dissolved Oxygen (DO) content, thereby, eliminates sensitive organisms like plankton, fish etc.

ii) Biocides, polychlorinated biphenyls (PCBs) and heavy metals directly eliminate sensitive aquatic organisms.
iii) Hot waters discharged from industries, when added to water bodies, lowers its DO content

DO, BOD, COD

- Presence of organic and inorganic wastes in water decreases the dissolved Oxygen (DO) content of the water. **Water having DO content below 8.0 mgL^{-1} may be considered as contaminated. Water having DO content below 4.0 mg L^{-1} is considered to be highly polluted.** A number of factors like surface turbulence, photosynthetic activity, O2 consumption by organisms and decomposition of organic matter are the factors which determine the amount of DO present in water.
- The higher amounts of waste increases the rates of decomposition and O_2 consumption, thereby decreases the DO content of water. The demand for O_2 is directly related to increasing input of organic wastes and is empressed as biological oxygen demand (BOD) of water.
- **Water pollution by organic wastes is measured in terms of Biochemical Oxygen Demand (BOD).** BOD is the amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water. It is expressed in milligrams of oxygen per litre of water. The higher value of BOD indicates low DO content of water.

- Since BOD is limited to biodegradable materials only. Therefore, it is not a reliable method of measuring pollution load in water. **Chemical oxygen demand (COD)** is a slightly better mode used to measure pollution load in water. It is the measure of oxygen equivalent of the requirement of oxidation of total organic matter present in water

2. Effects on human health:

- Mercury compounds in waste water are converted by bacterial action into extremely toxic methyl mercury, which can cause numbness of limbs, lips and tongue, deafness, blurring of vision and mental derangement

A cripling deformity called **Minamata disease** due to consumption of fish captured from mercury contaminated Minamata Bay in Japan was detected in 1952.

- Water contaminated with cadmium can cause **itai itai disease**/ouch-ouch disease (a painful disease of bones and joints) and cancer of lungs and liver.
- The compounds of lead cause anaemia, headache, loss of muscle power and bluish line around the gum.

3.Hazards of ground water pollution:

i. Excess nitrate in drinking water is dangerous for human health and may be fatal for infants Excess nitrate in drinking water reacts with hemoglobin to form non-functional methaemoglobin, and impairs oxygen transport. This condition is called methaemoglobinemia or **blue baby syndrome**.

ii. Excess fluoride in drinking water causes neuro-muscular disorders, gastro-intestinal problems, teeth deformity, hardening of bones and stiff and painful joints (skeletal fluorosis). High concentration of fluoride ions is present in drinking water in 13 states of India. The maximum level of fluoride, which the human body can tolerate is 1.5 parts per million (mg/1 of water). Long term ingestion of fluoride ions causes fluorosis.

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

- Arsenic contamination is a serious problem (in tube well dug areas) in the Ganges Delta, west bengal causing serious arsenic poisoning to large numbers of people. ***A 2007 study found that over 137 million people in more than 70 countries are probably affected by arsenic poisoning of drinking water.***

iv. Biological Magnification **v.** Eutrophicaiton

Control Measures

1) Riparian buffers
2) Treatment of sewage water and the industrial effluents should be done before releasing it into water bodies.
3) Hot water should be cooled before release from the power plants
4) Domestic cleaning in tanks, streams and rivers, which supply drinking water, should be prohibited.
5) Excessive use of fertilizers and pesticides should be avoided.
6) Organic farming and efficient use of animal residues as fertilizers.
7) Water hyacinth (an aquatic weed) can purify water by taking some toxic materials and a number of heavy metals
8) ***Oil spills in water can be cleaned with the help of bregoli*** – a by-product of paper industry resembling saw dust, oil zapper, micro-organisms.

The steps taken by the Government to address the issues of water pollution include the following:-

1) Preparation of action plan for sewage management and restoration of water quality in aquatic resources by State Governments;

2) Installation of **Online Effluent Monitoring System** to check the discharge of effluent directly into the rivers and water bodies;
3) Setting up of monitoring network for assessment of water quality.
4) Action to comply with effluent standards is taken by SPCBs / PCCs to improve the water quality of the rivers;

5) Financial assistance for installation of **Common Effluent Treatment Plants for cluster of Small Scale Industrial units**;
6) Issuance of directions for implementation of **Zero Liquid Discharge**;

7) Issuance of directions under **Section 5 of Environment (Protection) Act, 1986** to industries and under **Section 18(1)(b) of Water (Prevention and Control of Pollution) Act, 1974;**

8) Implementation of National Lake Conservation Plan (NLCP) and National Wetland Conservation Programme (NWCP) for conservation and management of identified lakes and wetlands in the country which have been merged in February, 2013 into an integrated scheme of **National Plan for Conservation of Aquatic Eco-systems (NPCA)** to undertake various conservation activities including interception, diversion and treatment of waste water, pollution abatement, lake beautification, biodiversity conservation, education and awareness creation, community participation

Control measures Soil Pollution • Reducing chemical fertilizer and pesticide use • Use of bio pesticides, bio fertilizers.

• Organic farming • **Four R's: Refuse, Reduce, Reuse, and Recycle** • Afforestation and Reforestation

• Solid waste treatment • Reduction of waste from construction areas

E – Waste in India

• "The Global E-Waste Monitor 2014", **17 lakh tonnes of e-waste generation was reported in the country in 2014**. No comprehensive State-wise inventorization of e-waste generation in the country has been done.

• The 65 cities generate more than 60% of the total generated e-waste, whereas, 10 states generate 70% of the total e-waste.

• **Most of the e-waste is recycled in India in unorganized units**, which engage significant number of manpower. Recovery of metals by primitive means is a most hazardous act. The recycling process, if not carried out properly, can cause damage to human being through inhalation of gases during recycling, contact of the skin with hazardous substances and contact during acid treatment used in recovery process.

• Proper education, awareness and most importantly alternative cost effective technology need to be provided so that better means can be provided to those who earn the livelihood from this.

• A holistic approach is needed to address the challenges faced by India in e-waste management. A suitable mechanism needs to be evolved to **include small units in unorganized sector and large units in organized sector into a single value chain**.

Treatment and disposal of solid waste

i) Open dumps

The waste is untreated, uncovered, and not segregated. It is the breeding ground for flies, rats, and other insects that spread disease. The rainwater run-off from these dumps contaminates nearby land and water thereby spreading disease.

ii) Landfills

- generally located in urban areas. It is a pit that is dug in the ground. The garbage is dumped and the pit is covered with soil everyday thus preventing the breeding of flies and rats and the site can thereafter be developed as a parking lot or a park..
- Problems - All types of waste are dumped in landfills and when water seeps through them it gets contaminated and in turn pollutes the surrounding area. This **contamination of groundwater and soil through landfills is known as leaching.**

iii) Sanitary landfills

is more hygienic and built in a methodical manner to solve the problem of leaching. These are lined with materials that are impermeable such as plastics and clay, and are also built over impermeable soil. Constructing sanitary landfills is very costly

iv) Incineration plants

- The process of burning waste in large furnaces at high temperature is known as incineration. In these plants the recyclable material is segregated and the rest of the material is burnt and ash is produced.
- Burning garbage is not a clean process as it produces tonnes of toxic ash and pollutes the air and water. A large amount of the waste that is burnt here can be recovered and recycled.

v) Pyrolysis

- It is a process of combustion in absence of oxygen or the material burnt under controlled atmosphere of oxygen. It is an alternative to incineration. The gas and liquid thus obtained can be used as fuels. Pyrolysis of carbonaceous wastes like firewood, coconut, palm waste, corn combs, cashew shell, rice husk paddy straw and saw dust, yields charcoal along with products like tar, methyl alcohol, acetic acid, acetone and a fuel gas.

vi) Composting

- Composting is a biological process in which micro-organisms, mainly fungi and bacteria, decompose degradable organic waste into humus like substance in the presence of oxygen.
- This finished product, which looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants.
- It increases the soil's ability to hold water and makes the soil easier to cultivate. It helps the soil retain more plant nutrients
- It recycles the nutrients and returns them back to soil as nutrients.

vii) Vermiculture

- It is also known as earthworm farming. In this method, Earth worms are added to the compost. These worms break the waste and the added excreta of the worms makes the compost very rich in nutrients.

viii) Four R's

Waste Minimization Circles (WMC) helps Small and Medium Industrial Clusters in waste minimization in their industrial plants.

- This is assisted by the **World Bank** with the **Ministry of Environment and Forests** acting as the nodal ministry. The project is being implemented with the assistance of **National Productivity Council (NPC), New Delhi.**
- The initiative also aims to realize the objectives of the **Policy Statement for Abatement of Pollution (1992)**, which states that the government should educate citizens about environmental risks, the economic and health dangers of resource degradation and the real economic cost of natural resources.
- The policy also recognizes that citizens and NGOs play a role in environmental monitoring, therefore, enabling them to supplement the regulatory system and recognizing their expertise where such exists and where their commitments and vigilance would be cost effective.

PLASTIC POLLUTION

The marine resource covering 70% of the earth's surface is a key asset in the biosphere. Of the nearly 1.5 million species known, nearly a quarter million live in the world's oceans. More importantly, nearly 50% of the global primary production takes place in the upper stratum of sea water. Seafood presently represents 20% of the protein in global diet.
The health of the marine food web and the fisheries resources invariably depend upon the long-term viability of the

autotrophic algae (phytoplankton – primary producer) and the zooplankton (primary consumers) in the marine food pyramid. Plastics pollution can interfere with the plankton species that form the foundation of the food web, and other organisms adversely affecting the delicate balance in the marine ecosystem.

Plastics as a Waste Material- in Marine Environment

a) The rate of UV-induced photo-oxidative degradation of plastics floating or submerged at sea is very much slower than that exposed to the same solar radiation on land.
b) Unlike on land there is no easy means of retrieval, sorting and recycling of plastic waste that enters into ocean environment.

Impact of Microparticles

Challenging the Antarctic krill and other zooplankton with plastic beads that are about 20 microns or so in size has demonstrated that these microparticulates are readily ingested by these organisms. They appear to ingest the particles unselectively, and the ingestion rates depend on the concentration of particles in the environment. While physical obstruction or indirect interference with physiology is always possible (as with sea birds showing satiation on ingesting plastics) the material will pass through the animal virtually unchanged. The concern, however, is that plastics exposed to sea water tends to concentrate toxic and non-toxic organic compounds present in the sea water at low concentrations. These, including PCBs, DDT, and nonylphenols, have very high partition coefficients and are very efficiently concentrated in the plastic material. The impact of negatively buoyant plastic waste (such as nylon net fragments) on benthic species has remained virtually unaddressed.

Plastics as a Waste Material- in Land Environment

(i) Choking of drains by plastic carry bags which may lead to unhygienic environment and water borne diseases,
(ii) Causing of illness and possible death of animals that may feed on plastics from garbage bins,
(iii) Non-biodegradable/impervious nature of plastics disposed on soil which may arrest recharge of ground water aquifers

(iv) presence of additives and plasticizers, fillers, flame retardants and pigments used in the plastic products which have potential to cause adverse health impact and ground water pollution.

BIOREMEDIATION

- Bioremediation is the use of microorganisms to degrade the environmental contaminants into less toxic forms.
- The process of bioremediation can be monitored indirectly by measuring the Oxidation Reduction Potential or redox in soil and groundwater, together with pH, temperature, oxygen content, electron acceptor/ donor concentrations, and concentration of breakdown products (e.g. carbon dioxide)

(a) In situ bioremediation techniques

- **Bioventing** – supply of air and nutrients through wells to contaminated soil to stimulate the growth of indigenous bacteria. It is used for simple hydrocarbons and can be used where the contamination is deep under the surface.
- **Biosparging** - Injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of contaminants by naturally occurring bacteria
- **Bioaugmentation** - Microorganisms are imported to a contaminated site to enhance degradation process

(b) Ex situ bioremediation techniques

- **Landfarming** - contaminated soil is excavated and spread over a prepared bed and periodically tilled until pollutants are degraded. Goal is to stimulate indigenous biodegradative microorganisms and facilitate aerobic degradation of contaminants.
- **Biopiles** - it is a hybrid of landfarming and composting. Essentially, engineered cells are constructed as aerated composted piles. Typically used for treatment of surface contamination with petroleum hydrocarbons.
- **Bioreactors** – it involves the processing of contaminated solid material (soil, sediment, sludge) or water through an engineered containment system.
- **Composting** Using bioremediation techniques, **TERI has developed a mixture of bacteria called 'oilzapper'** which degrades the pollutants of oil-contaminated sites, leaving behind no harmful residues. This technique is not only environment friendly, but also highly cost effective.

Genetic engineering approaches

Phytoremediation is use of plants to remove contaminants from soil and water .

- **Phytoextraction / phytoaccumulation** is the process by which plants accumulate contaminants into the roots and above ground shoots or leaves.
- **Phytotransformation / phytodegradation** refers to the uptake of organic contaminants from soil, sediments, or water and their transformation to more stable, less toxic, less mobile form.
- **Phytostabilization** is a technique in which plants reduce the mobility and migration of contaminated soil. Leachable constituents are adsorbed and bound into the plant structure so that they form unstable mass of plant from which the contaminants will not re-enter the environment.
- **Phytodegradation / rhizodegradation** is the breakdown of contaminants through the activity existing in the rhizosphere. This activity is due to the presence of proteins and enzymes produced by the plants or by soil organisms such as bacteria, yeast, and fungi.
- **Rhizofiltration** is a water remediation technique that involves the uptake of contaminants by plant roots. Itis used to reduce contamination in natural wetlands and estuary areas.
- **Mycoremediation** is a form of bioremediation in which fungi are used to decontaminate the area.
- **Mycofiltration** is a similar process, using fungal mycelia to filter toxic waste and microorganisms from water in soil.

About half of the acidity in the atmosphere falls back to earth through dry deposition. In India the first report of acid rain came from Bombay in 1974. Instances of acid rain are being reported from metropolitan cities. In India, the annual SO_2 emission has almost doubled in the last decade due to increased fossil fuel consumption. Lowering of soil pH is reported from north-eastern India, coastal Karnataka and Kerala, parts of Orissa, West Bengal and Bihar.

Chemistry of Acid Rain

1. The atmosphere receives oxides of sulfur and nitrogen from natural and man-made sources.
2. Some of these oxides fall back directly to the ground as dry deposition, either close to the place of origin or some distance away.
3. Sunlight stimulates the formation of photo-oxidants (such as ozone) in the atmosphere.
4. These photo-oxidants interact with the oxides of sulfur and nitrogen to produce H_2SO_4 and HNO_3 by oxidation.
5. The oxides are of sulfur and nitrogen, photo-oxidants, and other gases (like NH_3)
6. Acid rain containing ions of sulfate, nitrate, ammonium and hydrogen falls as wet deposition.

Impact Of Acid Rain

(a) Soil

- The exchange between hydrogen ions and the nutrient cations like potassium and magnesium in the soil cause leaching of the nutrients, making the soil infertile. This is accompanied by a decrease in the respiration of soil organisms.
- An increase in ammonia in the soil due to a decrease in other nutrients decreases the rate of decomposition.
- The nitrate level of the soil is also found to decrease.
- The impact of acid rain on soil is less in India; because Indian soils are mostly alkaline, with good buffering ability.

(b) Vegetation

Acid rains affect trees and undergrowth in forest in several ways, causing reduced growth or abnormal growth:

- Discoloration and loss of foliar biomass
- Loss of feeder-root biomass, especially in conifers and Premature senescence (aging) of older needles in conifers
- Increase in susceptibility of damage to secondary root and foliar pathogens
- Prodigious production of lichens on affected trees and Death of affected trees.

(c) Micro organisms

- pH determines the proliferation of any microbial species in a particular environment and the rate at which it can produce.
- The optimum pH of most bacteria and protozoa is near neutrality; most fungi prefer an acidic environment, most blue-green bacteria prefer an alkaline environment. So after a long run of acid rain, microbial species in the soil and water shift from bacteria-bound to fungi-bound and cause an imbalance in the microflora.
- This causes a delay in the decomposition of soil organic material, and an increase in fungal disease in

aquatic life and forests.

(d) Wild life

- Acid rain can directly affect the eggs and tadpoles of frogs and salamanders that breed in small forest ponds.
- can indirectly affect wildlife by allowing metals bound on soils and sediments to be released into the aquatic environment, where toxic substances may be ingested by animals, like birds, that feed in such an environment.

(e) Humans

- The obvious ones are bad smells, reduced visibility; irritation of the skin, eyes and the respiratory tract.
- Some direct effects include chronic bronchitis, pulmonary emphysema and cancer. Some indirect effects include food poisoning vis a vis drinking water and food.
- An increase in the levels of toxic heavy metals like manganese, copper, cadmium and aluminium also contribute to the detrimental effects on human health.

Trigger Effect of Acid Rain on Pollutants:

(i) Mercury:

- Methyl mercury and related short chain alkyl mercurial compounds are most dangerous to humans, as they accumulate in edible fish tissue.
- Although acid deposition may not increase the production of methyl mercury, it may increase the partitioning of methyl mercury into the water column.
- The use of lime has helped in reducing the mercury levels in fish.

(ii) Aluminium:

- Acidified waters are known to leach substantial amounts of aluminium from watersheds.
- Even at relatively low levels, aluminium has been implicated in dialysis dementia, a disorder of the central nervous system, which may be toxic to individuals with impaired kidney function.

(iii) Cadmium:

- Cadmium can enter the drinking water supply through corrosion of galvanized pipe or from the copper-zinc through corrosion of galvanized piper or from the copper-zinc solder used in the distribution systems.
- A decrease in water pH from 6.5 to 4.5 can result in a fivefold increase in cadmium and could cause renal tubular damage.

(iv) Lead:

- Foetuses and infants are highly susceptible to drinking water lead contamination.
- High blood lead levels in children (>30 mg/Ml) are believed to induce biochemical and neurophysiological dysfunction.
- However, lower than normal blood levels of lead can cause mental deficiencies and behavioural problems.

(v) Asbestos:

Asbestos in natural rock can be released by acidic waters

Control Measures:

Reducing or eliminating the sources of pollution by

- Buffering- the practice of adding a neutralizing agent to the acidified water to increase the pH is one of the important control measures. Usually lime in the form of calcium oxide and calcium carbonate is used.
- Reducing the emission of SO_2 from power stations by burning less fossil fuel, using alternate energy sources like tidal, wind, hydropower etc.,
- using low sulphur fuel and desulphurization
- decreasing emission of NOx from power stations and Modification of engines.
- Emissions of SOx can be controlled by Converting to sulphuric acid, Converting it to elemental sulphur. Neutralizing it and using it in the manufacture of other products.

CATEGORIZATION OF INDUSTRIAL SECTORS

- The Ministry of Environment, Forest and Climate Change (MoEFCC) has developed the criteria of categorization of industrial

sectors, **Red, Orange, Green and White categories based on the Pollution Index (0-100)** which is a function of the emissions (air pollutants), effluents (water pollutants), hazardous wastes generated and consumption of resources.

- "The new category of White industries which is practically non-polluting will not require Environmental Clearance (EC) and Consent and will help in getting finance from lending institutions. No Red category of industries shall normally be permitted in the ecologically fragile area / protected area.

Renewable Energy

The Government has up-scaled the target of renewable energy capacity to 175 GW by the year 2022 which includes 100 GW from solar, 60 GW from wind, 10 GW from biopower and 5 GW from small hydro-power. Total installed capacity in India from renewable energy on April, 2016 is 42,800 MW. Majority of the total capacity is developed by the State sector accounting for about 39% followed by Private sector for about 31% and Centre hold about 29% each.

Potential of solar energy in India

- India has the potential to generate 35 MW/km2 using solar photovoltaic and solar thermal energy.
- Solar energy of about 5,000 trillion kWh per year is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Hence both technology routes (solar thermal and solar photovoltaic) can effectively be harnessed
- states with very high solar radiation are Rajasthan, northern Gujarat and parts of Ladakh region, AP, Maharashtra and MP.

Installed capacity – India

The current installed capacity of solar in grid connected power crossed 10,000 MW, as on 2017, as per MNRE estimates. A major initiative called '**The National Solar Mission'** was formulated by Government of India and its state governments.

One of the main features of the Mission is to make India a global leader in solar energy and the mission envisages an installed solar generation capacity of 100 GW (revised target) by 2022.

International Solar Alliance launched at the **CoP21 Climate Conference in Paris** on 30th November as a special platform for mutual cooperation among 121 solar resource rich countries lying fully or partially between Tropic of Cancer and Tropic of Capricorn. The alliance is dedicated to address special energy needs of ISA member countries. **International Agency for Solar Policy and Application (IASPA)** will be the formal name of International Solar Alliance. The ISA secretariat will be set up in **National Institute of Solar Energy, Gurgaon.**

Objectives

1. to force down prices by driving demand;
2. to bring standardization in solar technologies
3. to foster research and development.

Prime Minister coined the new term "Surya Putra" for all the **nations which fall between Tropic of Cancer and Tropic of Capricorn**, and which have been invited to join the alliance. The other term used for these countries is "**Sunshine Countries**". IESS 2047 stands for **India Energy Security Scenarios 2047** calculator which has been launched by India to explore the potential of future energy scenarios for India.

LUMINESCENT SOLAR CONCENTRATORS is a device that uses a thin sheet of material to trap solar radiation over a large area, before directing the energy (through luminescent emission) to cells mounted on the thin edges of the material layer. The thin sheet of material typically consists of a polymer (such as polymethylmethacrylate (PMMA)), doped with luminescent species such as organic dyes, quantum dots or rare earth complexes.

What is the need for LSCs?

- The main motivation for implementing LSCs is to replace a large area of expensive solar cells in a standard flat-plate PV panel, with a cheaper alternative. Therefore there is reduction in both the cost of the module (£/W) and the solar power produced (£/kWh).
- A key advantage of over typical concentrating systems is that LSCs can collect both direct and diffuse solar radiation. Therefore tracking of the sun is not required.
- LSCs are excellent candidates for building integrated photovoltaics (BIPV) and for the cloudier northern climates.

Ideal LSC

- A broad absorption range to utilize the solar spectrum efficiently.
- 100% emission of light from the absorbing luminescent species.
- A large shift between the absorption and emission spectra to reduce absorption losses.
- Long term stability.

International Renewable Energy Agency (IRENA) has 150 member nations with Headquarters in Abu Dhabi. It is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy,

WIND ENERGY

Germany, USA, Denmark, Spain and India – account for 80% of the world's installed wind energy capacity.

Potential of wind energy in India

The National Institute of Wind Energy (NIWE) has recently launched Wind Energy Resource Map of India at 100 m above ground level (AGL) on online Geographic Information System platform. The wind energy potential in the country at 100 m AGL is over 302 GW. Gujarat has the maximum potential followed by Karnataka, Maharashtra, Andra Pradesh according to the resource map.

Wind energy target

- 60000 MW (60 GW) by 2022
- 200000 MW (200 GW) by 2022

Capacity installed

- Tamil Nadu – 7200 MW
- Maharastra – 4000 MW
- Karnataka – 2700 MW
- Rajasthan – 2700 MW

Andra Pradesh, Madhya Pradesh, kerala are minor players with installed capacity of less than 1000 MW.

National Offshore Wind Energy Policy, 2015: Under this Policy, the **Ministry of New & Renewable Energy (MNRE)** has been authorized as the Nodal Ministry for use of offshore areas within the Exclusive Economic Zone (EEZ) of the country and the **National Institute of Wind Energy (NIWE)** has been authorized as the Nodal Agency for development of offshore wind energy in the country and to carry out allocation of offshore wind energy blocks, coordination and allied functions with related ministries and agencies.

National Wind Energy Mission (Proposed): The setting up of a Mission would help in
(a) achieving the targets of 12th Plan and energy generation from renewable energy as set under **NAPCC**,
(b) addressing the issues and challenges, such as precise resource assessment, effective grid integration, improvement in technology and manufacturing base, to maintain its comparative advantage in the wind sector.

HYDRO POWER

(1) Impoundment (2) Diversion (3) Pumped storage

Small Hydro Power (SHP) any hydro power project which has an installed capacity of less than 25 MW. It is in most cases run-of-river, where a dam or barrage is quite small, usually just a weir with little or no water is stored. Therefore run-of-river installations do not have the same kind of adverse effect on the local environment as large-scale hydro projects. Small hydropower plants can serve the energy needs of remote rural areas independently. India and China are the major players of the SHP sector, holding the highest number of installed projects.

- An estimated 5,415 sites of small hydro have been identified with a potential of around 19,750 MW.
- River projects in the Himalayan states and irrigation canals in other states have massive potential for development of SHP
- According to the 12th five year plan targets, capacity addition from Small Hydro Projects is targeted at 2.1 GW in 2011-17
- The Ministry of New and Renewable Energy is encouraging development of Small Hydro Projects in both the public and private sector and aims to exploit at least 50% of the current potential in the next 10 years.

The cumulative installed capacity of Small Hydro Projects amount to 3726 MW.

OCEAN THERMAL ENERGY On an average, the 60 million sq km. of the tropical seas absorb solar radiation equivalent to the heat content of 245 billion barrels of oil. The process of harnessing this energy is called OTEC (ocean thermal energy conversion). It uses the temperature differences between the surface of the ocean and the depths of about 1000m to operate a heat engine, which produces electric power

Wave energy The first wave energy, project with a capacity of 150MW, has been set up at Vizhinjam near Trivandrum.

Tidal energy A major tidal wave power project costing of Rs.5000 crores, is proposed to be set up in the Hanthal Creek in the Gulf of Kutch in Gujarat.

Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel.

Anaerobic Digestion/Biomethanation is a scientific process whereby anaerobic microorganisms in an anaerobic environment decompose biodegradable matter producing methane-rich biogas and effluent. The three functions that take place sequentially are hydrolysis, acidogenesis and methanogenesis.

Combustion/Incineration waste is directly burned in the presence of excess air (oxygen) at high temperatures (about 800°C), liberating heat energy, inert gases and ash. Combustion results in transfer of 65–80% of heat content of the organic matter to hot air, steam and hot water.

Pyrolysis/Gasification the organic material is heated in the absence of air until the molecules thermally break down to become a gas comprising smaller molecules (known collectively as **syngas**). It can also take place as a result of partial combustion of organic matter in the presence of a restricted quantity of oxygen or air. The gas so produced is known as producer gas. ***The gases produced by pyrolysis mainly comprise carbon monoxide (25%), hydrogen and hydrocarbons (15%), and carbon dioxide and nitrogen (60%)***. The next step is to 'clean' the syngas or producer gas. Thereafter, the gas is burned in internal combustion (IC) engine generator sets or turbines to produce electricity.

COGENERATION is producing two forms of energy from one fuel. One of the forms of energy must always be heat and the other may be electricity or mechanical energy. As the low-pressure steam has a large quantum of heat which is lost in the process of condensing, the efficiency of conventional power plants is only around 35%. In a cogeneration plant, the low-pressure exhaust steam coming out of the turbine is not condensed, but used for heating purposes in factories or houses and thus very high efficiency levels, in the range of 75%–90%, can be reached.

Since co-generation can meet both power and heat needs, it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption. Even at conservative estimates, the potential of power generation from co-generation in India is more than 20,000 MW. Since India is the largest producer of sugar in the world, bagasse-based cogeneration is being promoted.

The potential for cogeneration lies in facilities with joint requirement of heat and electricity, primarily sugar and rice mills, distilleries, petrochemical sector and industries such as fertilizers, steel, chemical, cement, pulp and paper, etc.

Potential in India

- 32% of the total primary energy usage in the country with more than 70% of the Indian population dependent on it for its energy needs.
- The current availability of biomass is estimated at about 450-500 million tonnes annually translating to a potential of around 18000 MW. In addition, about 5000 MW additional power could be generated through bagasse based cogeneration in the country's 550 Sugar mills
- It attracts over Rs 600 crore in investments annually creating rural employment of more than 10 million man days whilst generating more than 5000 million units of electricity.

Installed capacity in India

- Approximately over 300 biomass power and cogeneration projects aggregating 3700 MW have been installed in the country for feeding power to the grid. Also, 30 biomass power projects aggregating about 350MW are under different stages of implementation.
- AP, TN, Karnataka, Maharashtra and UP are the leading states in the implementation of bagasse cogeneration projects.
- The Government plans to meet 20% of the countries diesel requirements by 2020 using biodiesel. Potential sources of

biodiesel production have been identified in wild plants such as jatropha curcas, neem, mahua, karanj, Simarouba (exotic tree)

- Several incentive schemes have been introduced to rehabilitate waste lands through the cultivation of Jatropha

- **Central Finance Assistance (CFA)** is provided by the **Ministry of New and Renewable Energy (MNRE)** in the form of capital subsidy and financial incentives to biomass energy projects in India.

Potential of waste-to-energy

- estimated potential of about 225 MW from all sewage and about 1460 MW from Municipal Solid Waste (MSW) in India totaling around 1700 MW of power.
- current potential to recover 1,300 MW of power from industrial wastes, which is projected to increase to 2,000 MW by 2017.
- The total installed capacity of grid interactive power from Waste to energy is 99.08 MW of grid power and about 115.07 MW of off-grid power.

Major Constraints Faced by the Indian Waste to Energy Sector

- **Choice of technology** - Waste-to-Energy is still a new concept in India. Most of the proven and commercial technologies in respect of urban wastes are required to be imported;
- **High costs** - The costs of the projects especially based on bio-methanation technology are high as critical equipment for a project is required to be imported.
- **Improper segregation** - India lacks a source separated waste stream, owing to the low level of compliance of **Municipal Solid Waste (MSW) Rules 2000** by the Municipal Corporations/ Urban Local Bodies. The organic waste is mixed with the other types of waste. Hence the operations of the waste to energy techniques are hindered and a lack of smoothness causes the attempts to be short lived.
- **Lack of policy support** - Lack of conducive policy guidelines from State Governments in respect of allotment of land, supply of garbage and power purchase / evacuation facilities.

GeoThermal Potential in India for producing around 10,600 MW of power from geothermal resources. Although India was among the earliest countries to begin geothermal projects since the 1970's, at present there are no operational geothermal plants in India. 340 hot springs were identified across India.

Recent Developments:

In 2013, India's first geothermal power plant was announced to be set up in Chhattisgarh. The plant would be set up at Tattapani in the Balrampur district. Satellites like the IRS-1 have played an important role, through infrared photographs, in locating geothermal areas.

Challenges

1) **High generation costs** relating to geothermal power plants are incurred due to resource exploration and plant construction.
2) **Drilling costs** Although the cost of generating geothermal electricity has decreased by 25% during the last two decades, exploration and drilling remain expensive and risky. It is because rocks in geothermal areas are extremely hard and hot, developers must frequently replace drilling equipment.
3) **Transmission barrier** Geothermal power plants must be located near specific areas near a reservoir because it is not practical to transport steam or hot water over distances greater than two miles. Since many geothermal resources are located in rural areas, developers may be limited by their ability to supply electricity to the grid.
4) **Accessibility** many of these areas are located in harsh areas or high up in mountains.
5) **Execution challenges** Harmful radioactive gases can escape from deep within the earth through the holes drilled by the constructors. The plant must be able to contain any leaked gases and ensure safe disposal of the same.

FUEL CELLS convert the chemical energy of a fuel directly and very efficiently into electricity (DC) and heat, thus doing away with combustion. A fuel cell consists of an electrolyte sandwiched between two electrodes. Oxygen passes over one electrode and hydrogen over the other, and they react electrochemically to generate electricity, water, and heat.

Fuel cells for automobile transport Compared to vehicles powered by the internal combustion engine, fuel-cell powered vehicles have very high energy conversion efficiency, and near-zero pollution, CO_2 and water vapour being the only emissions. Fuel-cell-powered EV's (electric vehicles) score over battery operated EV's in terms of increased efficiency and easier and faster refuelling.

Fuel cells for power generation

Fuel cells can supply combined heat and power to commercial buildings, hospitals, airports and military installation at remote locations. Fuel cells have efficiency levels up to 55% as compared to 35% of conventional power plants. The emissions are significantly lower (**CO2 and water vapour being the only emissions**). Fuel cell systems are modular (i.e. additional capacity can be added whenever required with relative ease) and can be set up wherever power is required.

Constraint

High initial cost is the biggest hurdle in the widespread commercialization of fuel cells.

REN21 is the global renewable energy policy multi-stakeholder network that connects a wide range of key actors from:

• Governments • International organisations • Industry associations • Science and academia as well as civil society

To facilitate knowledge exchange, policy development and joint action towards a rapid global transition to renewable energy. REN21 promotes renewable energy to meet the needs of both industrialized and developing countries that are driven by climate change, energy security, development and poverty alleviation.

REN21 is an international non-profit association and committed to the following objectives:

- Providing policy-relevant information and research based analysis on renewable energy to decision makers, multipliers and the public to catalyze policy change
- Offering a platform for inter-connection between multi stakeholder actors working in the renewable energy field worldwide and identifying barriers as well as working to bridge existing gaps to increase the largescale deployment of renewable energy worldwide.

INDIAN HIMALAYAN REGION (IHR) Services

- Among other services, the region, with its large area under permanent snow cover and glaciers, forms a unique water reservoir that feeds several important perennial rivers.
- With its vast green cover, **IHR also acts as a giant carbon 'sink'**.

IMPACT - SOLID WASTE The continued expansion in urban settlements, influx of visitors, trekkers and mountaineers, untreated sewage and local air pollution due to vehicles has been continuously increasing

IMPACT - TOWN PLANNING

Large scale land instabilities, drying up of natural water sources, waste disposal problems and changing sociocultural values along with Deforestation activities - cutting in an area causes ecological damage and slope instability in adjacent areas.

INITIATIVES

Ban on Plastic in HP

- State government enacted the Himachal Pradesh **Non Biodegradable Garbage (Control) Act, 1995** in order to prevent throwing or depositing non- biodegradable garbage in public drains, roads.
- It has then increased the minimum thickness of plastic carry bags to 70 microns of virgin material, which exceeded the 20 micron thickness recommended by Central Rules.
- Further, the state Government has taken a Cabinet decision to ban plastics altogether in the entire state since 2009.

Participatory Conservation of Lakes in the Region

- To conserve the water body, the residents have switched on to a scientific garbage disposal system – under the project name **'Mission Butterfly' by Nainital Lake Conservation Project**.
- The sweepers, on a small monthly charge, collect waste from each household and directly transfer it to the compost pits. Apart from the residents, schools and hotel owners have extended full cooperation to the authorities, to save its precious eco-

system.

- In addition, they are able to generate income and employment by converting it to manure.

Conservation of Dal lake

- The lake is in peril due to anthropogenic pressure and overall deterioration of surrounding environment.
- The lake has been included in the lake conservation programme of the MoEF, GOI.
- The Lake and Waterways Development Authority (LAWDA), Srinagar, in collaboration with **Centre for Environment Education (CEE)** and other NGOs has taken up the initiative for lake conservation through education and mass awareness. Use of polythene carry bags has also been banned in the lake area.

Assam Hill Land and Ecological Sites Act, 2006 to prevent indiscriminate cutting of hills and filling up of water bodies in urban areas, which had led to serious ecological problems in places like Guwahati.

- Under the Act, the state government can bring any hill under its purview for protection.

Urban Development through JNNURM

- "The aim is to encourage reforms and fast track planned development of identified cities. Focus is to be on efficiency in urban infrastructure and service delivery mechanisms, community participation, and accountability of ULBs/ Parastatal agencies towards citizens".
- The duration of the mission is seven years starting from 2005-06with initially 13 towns.

Recommendations / solutions for Solid Waste

Recommendations / solutions - Hill Town Planning and Architectural Norms

1. Fragmentation of habitats in hill areas should be prevented.
2. Specific areas for rural/urban development should be designated.
3. No construction should be undertaken which fall in hazard zones or areas falling on the spring lines and first order streams.
4. Architectural and aesthetic norms for construction of buildings in mountain/hill areas should be enforced.
5. Deforestation activities shall not be undertaken unless appropriate measures are taken to avoid such damages.
6. An integrated development plan may be prepared taking into consideration environmental and other relevant factors
7. In highly seismic areas like Himalaya, all construction should incorporate earthquake resistant features
8. Location-specific technologies should be deployed for construction of buildings
9. "Green roads" having channels for collection of water for irrigation purposes should be made a part of the norm.

INITIATIVES

Harnessing Religious Sentiments for Conservation and sustainable management of natural resources in the eco-sensitive Himalayan areas. This can be done through:

- ***Encouraging them to undertake participatory plantation for rehabilitation of degraded areas*** (e.g., Badrivan initiative of GBPIHED in Uttarakhand).
- ***Promoting the concept of eco-cultural landscapes*** (e.g., Demazong – Buddhist landscape, Sikkim, and Apatani eco-cultural landscape, Arunachal Pradesh). Both landscapes are highly evolved with high level of economic and ecological efficiencies.
- ***Involving them in maintenance and strengthening of sacred groves/landscape*** (e.g., Sacred Groves of Meghalaya: The tribal communities – Khasis, Garos, and Jaintias, have a tradition of environmental conservation based on religious beliefs and customary law and are protected from any product extraction.

Ladakh Himalayan Homestays- Transforming Local Mindsets towards Snow Leopards

- The Himalayan Homestays programme fosters conservation-based community managed tourism development in remote settlements, by gradually building local capacity and ownership.
- It stands out as an example that aims to be sensitive to both host and visitor expectations without compromising the aspirations of host communities, and at the same time seeks to balance these aspects with conservation of the area's unique cultural and natural heritage.

Highlights of Sikkim's Ecotourism Policy

- "Sikkim - the Ultimate Tourist Destination" is the policy motto of the state. The state is employing a system of environmental fees, and permits for entries, and stay time restrictions in some environmentally sensitive high altitude/ pristine areas.
- Operationalization of tourism in various modes, such as **village tourism, nature tourism, wildlife tourism, trekking**

/adventure tourism, and cultural tourism in the state and institutionalization of tourism management at the community level.

- **Promotion and use of local art & craft, cuisines**, etc., along with organizing **tourism fairs and festivals**.
- **Imparting training in tourism related service industries**. The efforts made by Sikkim can be a basis of responsible tourism in other Himalayan states.

Adventure tourism Immense opportunities for adventure cum ecotourism in the Himalayan region (e.g., Annapurna Conservation Area project, Nepal; Nanda Devi Biosphere Reserve ecotourism approach, Uttarakhand) could be harnessed through community involvement.

Tourism + art and culture Linking of tourism with initiatives like Rural Business Hubs (RBH), as introduced in North East region, which envisages promotion of quality rural products like handloom, handicrafts, agro products, herbal products, bio-fuel, etc., may be considered as yet another aspect of promoting eco-tourism in the IHR.

Regulated entry The Government of Uttarakhand has restricted the number of tourists visiting the origin of the river Ganga – Gangotri area to 150 per day.

Recommendations / solutions

1. Pilgrimage tourism in Himalayas requires both development and regulation so as to reduce congestion and resultant pollution.
2. All existing sites should have adequate provision of garbage disposal and management.
3. An inventory of historical, sensitive and sacred sites including sacred groves should be prepared and their vulnerability should be assessed.
4. The access to such sites of incomparable value through vehicles needs to be restricted beyond a certain zone.

Recommendations / solutions – Promoting Ecotourism and Regulation of Commercial Tourism

1. Eco-tourism villages, parks, sanctuaries and other areas should be identified to establish a primary base for ecotourism.
2. Village communities, especially youths, and rural women should be involved in Ecotourism.
3. Restrictions on the entry of vehicles and visitors per day/ per group should be imposed in sensitive ecological sites.
4. Local art, crafts, cuisines, and dishes should be promoted and made an integral part of tourist experience in order to ensure economic benefits to the locals and their cultural integrity/ entity is not lost.
5. Best practices on commercial trekking should be imposed on a mandatory basis
6. Creation of log/bamboo huts should be promoted in busy mountain areas.

Recommendations / solutions for related segments Rejuvenation of Springs and Degraded Sites

- Special attention be paid to recharge of ground water and quality of mountain lakes/wetlands through restoration of forests.
- Detailed ***geological mapping*** should be conducted to identify the ***spring recharge zone*** and locate geological structures.
- ***Nuclear water prospecting technologies*** should be used to map the water sources and prevent the construction activities in such locations that could damage or adversely affect such sources.
- Engineering measures to protect recharge zone from biotic interferences
- ***Social fencing measures***,

(i) digging shallow infiltration trenches, mulching.
(ii) construction of stone-mud check dams in gullies to store rainwater and check soil erosion; and
(iii) land levelling, maintenance of crop field bunds to allow stagnation of rainwater should be enhanced.

- Vegetative measures with the aim to enhance rainwater infiltration and reduce rainwater runoff.
- Involvement of stakeholder community should be ensured at every step of the ***Spring Sanctuary Development***. The maintenance and aftercare of the interventions have to be ensured through their involvement.

Ecologically Safer Roads

- For construction of any road in the Himalayan region of more than 5 km length where the same may not be tarred roads and EIA is otherwise not required, environmental impact assessment should be carried out in accordance with the instructions to be issued for this purpose by the State Governments.
- Provision should be made in the design of the road for treatment of hill slope instabilities resulting from road cutting, cross drainage works and culverts using bioengineering and other appropriate techniques.
- Provisions should be made for disposal of debris from construction sites in appropriate manner at suitable and identified

locations so as not to affect the ecology of the area adversely. Further, the dumped material should be treated using bioengineering and other appropriate techniques.

- No stone quarrying should be carried out without proper management and treatment plan including rehabilitation plan.
- All hill roads should be provided with adequate number of road side drains and these drains shall be kept free from blockage for runoff disposal; further, the cross drains shall be treated suitably using bio-engineering and other appropriate technologies so as to minimize slope instability.
- The runoff from the road side drains should be connected with the natural drainage system in the area.
- Fault zones and historically land slide prone zones should be avoided during alignment of a road, where for any reason it is not possible to do so, the construction should be carried out only after sufficient measures have been taken to minimize the associated risks.
- Ridge alignment should be preferred to valley alignment.
- Alignment should be selected so as to minimise loss of vegetal cover.
- Encouragement should be provided for use of debris material for local development.

SAND MINING IN INDIA - ENVIRONMENTAL ISSUES

Sand mining is the process of removal of sand and gravel. Despite a Supreme Court order that prohibits sand mining without the requisite clearance from the required authorities and places limits on the quantities that can be mined, thousands of tons of sand is being illegally mined to meet the rising demand of construction industry and for extraction of minerals.

Sand acts as an aquifer, and as a natural carpet on the bottom of the river. Stripping this layer leads to downstream erosion, causing changes in channel bed and habitat type, as well as the deepening of rivers and estuaries, and the enlargement of river mouths. As the river system lowers, local groundwater is affected, which leads to water scarcities aggravating agriculture and local livelihoods. In terms of legal measures, **ground water shortages** have been noted as the patent problem with river sand mining. Less considered in legal action, but centrally relevant, experts also note substantial habitat and ecological problems, which include "***direct loss of stream reserve habitat, disturbances of species attached to streambed deposits, reduced light penetration, reduced primary production, and reduced feeding opportunities".***

1. **Revenue loss to the exchequer** For e.g.: It is estimated that in Noida and Greater Noida alone the loss to the exchequer is about Rs.1,000 crore, but theft on environment and ecology, can't even be calculated.

Environmental consequences of sand mining

1) **Forcing the river to change its course** Sand and boulders prevent the river from changing the course and act as a buffer for the riverbed.

2) **Illegally dredged sand is equivalent to robbing water**. Sand holds a lot of water, and when it is mindlessly mined and laden on to trucks, large quantities of water is lost in transit.
3) **Depletion of groundwater tables** Sand, on a riverbed it acts as a link between the flowing river and the water table and is part of the aquifer. For e.g.: Illegal and excessive sand mining in the riverbed of the Papagani catchment area in Karnataka has led to the depletion of groundwater levels and environmental degradation in the villages on the banks of the river in both Andhra Pradesh and Karnataka.

4) **Adversely impacting the habitat of micro-organisms** There are a lot of micro-organisms critical to soil structure and fertility. When sand is dredged, literally it takes away their habitat.
5) **Increased river erosion** When sand and boulders are removed in an unimpeded way using heavy machines, the erosion capacity of the river increases.

6) **Damage to roads and bridges** For e.g.: In Vishnuprayag the boulders that came down with the river water damaged a side of the dam and the waters spread out across causing heavy damage.
7) **Threat to agriculture** For e.g.: riverbed of the Bharathapuzha in kerala. Water tables have dropped dramatically and a land once known for its plentiful rice harvest now faces scarcity of water.

8) **Damage to coastal ecosystem** Eg: Kihim Beach off Alibaug, Shore levels have reduced, forcing residents to build walls to protect themselves from the sea. It wrecks the intertidal area and creates the imminent danger of saline water ingress into fresh water. Coastal sand mining destroys fisheries, disturbs coral, mangroves, wetlands and has led to

the near extinction of ghariyals, a crocodile species unique to India. A major impact of beach sand mining is the loss of protection from storm surges associated with tropical cyclones and tsunamis.

9) **Lesser availability of water** for industrial, agricultural and drinking purposes.

10) **Loss of employment to farm workers**.
11) **Threat to livelihoods**.

Suggestions

1. The most viable alternative is **'manufactured sand'**. It is produced in a stone crushing plant. M-sand is produced from stones which is used for aggregates, and the quality is consistent and even better than river sand. M-sand is relatively cheaper too.
2. **Use of fly ash** from industries as alternative should be promoted for construction purposes.
3. The government should exercise prudence when it comes to leasing out the riverbed for mining activities and also demarcate areas clearly and monitor mining through a suitable institutional mechanism.
4. **Periodic assessment** of how much sand can be sustainably mined, as the quantity can vary from a river to river and within a river from stretch to stretch has to be done.
5. The **use of intrusive techniques** such as the use of explosives and heavy excavator machines in sand mining **are largely destructive**.
6. In the mountain areas especially sand mining **should be carried out manually and sustainably**.
7. **A high level lobbying committee must be formed** and Laws has to be enforced in an efficient and unbiased way and decisive steps are to be taken for environmental solution.

Guidelines for Sustainable Sand & Minor Mineral Mining

1. **Where to mine and where to prohibit mining**: District Survey Report for each district in the country, taking the river in that district as one ecological system. Use of ISRO, remote sensing data and ground truthing.

2. **Sustainable mining**: Mining out material only that much which is deposited annually.
3. **Involvement of District authorities in the process**: The District-level Environment Impact Assessment Authority (DEIAA) headed by District Collector. The District Collector is to be assisted by the District Level Expert Appraisal Committee (DEAC) headed by Executive Engineer (Irrigation Department) being assigned the responsibility of granting environment clearance up to 5 hectare of mine lease area for minor minerals , mainly sand. So district administration, which is the key in assessing the requirement of sand in a district and prohibiting illegal sand mining in district is being involved directly in environmental clearance.

4. **Monitoring using scientific tools**: Stringent monitoring of movement of mined out material from source to destination using information technology tools, bar coding, SMS etc. The movement of sand is controlled through Transit Permit. The monitoring of mined out mineral, **Environmental Clearance**, EC conditions and enforcement of **Environment Management Plan (EMP)** will be ensured by the District Collector and the State Pollution Control Board. The monitoring of enforcement of EC conditions can be done by the **Central Pollution Control Board, Ministry of Environment, Forest and Climate Change** and the agency nominated by Ministry for the purpose.
5. **Guideline on handling cluster issues**: The original EIA notification does not provide for the procedure to handle cluster situation, which has been proposed in this guideline and will become part of the Notification. One EIA/EMP will be prepared for one cluster irrespective of number and size of mining leases in that cluster, if the area is more than 5 hectares.

PALM OIL – ENVIRONMENTAL ISSUES AND INDIA'S ROLE IN IT

Palm oil forms 33% of the world vegetable oil production mix. Indonesia and Malaysia contribute almost 87% of production of palm oil, whereas China and India constitute 34% of imports. Palm oil, at 48.7 Mn MT is the largest consumed edible oil in the world. As per WWF's estimates, expansion of oil palm plantations is likely to cause 4 million hectares of forest loss by 2020. ***According to USDA estimates, 75% of the global palm oil consumption is for food purposes,*** while 22% is for industrial/ non-food purposes. The remaining, though currently, of marginal quantity, is used for biodiesel.

INDIA and OIL PALM

Indonesian palm oil companies produce palm oil by destroying virgin rainforests and tiger habitat in Indonesia.
Indian huge palm oil imports from Indonesia is been accelerating the devastation of those rainforests.

Consumption of palm oil in India Palm oil has dominated Indian imports since the last two decades, for its logistical advantages, contractual flexibility, and consumer acceptance change in consumption patterns, availability, pricing, and policy changes. India is the largest importer of palm oil which is also the lowest priced oil. Palm oil contributes to around 62% of the total edible oils that are imported into the country. Almost 90% of the palm oil imported and produced domestically is used for edible/ food purposes, while the remaining is used for industrial/non-edible purposes.

State-wise Palm Oil Production in India Andhra Pradesh is the leading palm oil producing state in India contributing approximately 86 % of country's production, followed by Kerala (10%) and Karnataka (2%). Other palm oil producing states include Orissa, Tamil Nadu, Goa and Gujarat.

Major constraints in domestic cultivation of oil palm

- **Geographical location:** The ideal locations for oil palm trees are within 8 ^{o} latitude north and south of the Equator.
- **Irrigation:** Palms need regular rainfall throughout the year. However, they can withstand dry periods of 3-4 months depending on soils type without irrigation. Oil palm can be grown in Kerala, Andhra Pradesh, Karnataka, Goa and a few other areas, but only with irrigation. This places significant pressure on the hydrological system of the region
- **Long gestation periods:** Oil palm has very high productivity when compared to other oilseeds like mustard, however, the farmers would have to wait for four years for the trees in India to obtain yield.
- **Small farm holdings** with Indian farmers generally are challenging.
- **Limited investments by corporate sector** compared with Malaysia and Indonesia.

Policies Related to Production and Distribution of Palm Oil

- To provide relief, in particular BPL households, from the rising prices of edible oils, the Central Government introduced a scheme for distribution of up to 10 lakh tons of imported edible oils in 2008-09 at a subsidy of Rs 15/- per kg through State Governments/UTs
- OPDP was launched during 1991- 92 under the **"Technology Mission on Oilseeds and Pulses" (TMOP)**, with a focus on expansion of area under oil palm cultivation.
- From 2004-05, it is being implemented as part of the "**Integrated Scheme of Oilseeds, Pulses, Oil Palm & Maize**" (ISOPOM) and provides support for oil palm cultivation in 12 states: Andhra Pradesh, Assam, Gujarat, Goa, Karnataka, Kerala, Maharashtra, Mizoram, Orissa, Tamil Nadu, Tripura & West Bengal. For the year 2011-12, the government rolled out the **Oil Palm Area Expansion (OPAE) Programme** in order to bring an additional 60,000 hectares area under oil palm cultivation.
- The government has also announced various subsidies for oil palm growers for planting, buying pump set and drip-irrigation systems, partial compensation in case of loss during the gestation period and support for processing units. **Roundtable on Sustainable Oil (RSPO)** was established in 2004 to promote the production and use of sustainable palm oil for people, planet and prosperity. RSPO is a membership based organisation with oil palm growers, palm oil processers and traders, consumer good manufactures, NGOs and retailers. **RSPO impact** Presently 14 % of palm oil globally is certified by RSPO. It is however important to understand that palm oil itself is not the problem, but rather how palm oil is produced. When done right, palm oil can be a catalyst for development and to improve livelihoods. It can also enhance biodiversity and sequestrate carbon di oxide when planted on degraded lands.

COLONY COLLAPSE DISORDER

Pollinators transfer pollen and seeds from one flower to another, fertilizing the plant so it can grow and produce food. Crosspollination helps at least 30% of the world's crops and 90% of our wild plants to thrive. Without bees to spread seeds, many plants – including food crops – would die off. CCD is a new tag name presently being given to a condition that is characterized by an unexplained rapid loss of a Bee colony's adult/worker bee population. Reduction or loss of bee population has been seen in the history and known by the name such as disappearing disease, spring dwindle, May disease, autumn collapse, and fall dwindle disease

CAUSES

1. **Global warming** causes flowers to bloom earlier or later than usual. When pollinators come out of hibernation, the flowers that provide the food they need to start the season has already bloomed.
2. **Pesticide (neonicotinoids, a neuroactive chemical)** It's not that the pesticides which are aimed at other insects are killing the bees outright. Rather that sublethal exposure of pesticides in nectar and pollen may be interfering with the honeybees internal radar, preventing them from gathering pollen and returning safely to the hive.

3. **Varroa mite – parasites** European foulbrood (A bacterial disease that is increasingly being detected in U.S. bee colonies) microsporidian fungus Nosema.
4. **Malnutrition** Researchers have identified some specific nutrients that bees need, get from honey, and don't get from corn syrup. When honeybees collect nectar from flowers, they also gather pollen and a substance called propolis, which they use to make waxy honeycombs. The pollen and propolis are loaded with three types of compounds that can help the bees detoxify their cells and protect themselves from pesticides and microbes.
5. **Metal Pollution** Bees absorbing metal pollution from flowers that absorbed it from the soil that absorbed it from modern machines and vehicles.
6. **Habitat loss** brought by development, abandoned farms, growing crops without leaving habitat for wildlife and growing gardens with flowers that are not friendly to farmers.

- Bee research must be strengthened, and must also be broadened to include research on pollinators besides honey bees.
- **Integrated Pest Management (IPM)** techniques should be used to minimize pesticide us and risk to bees. If CCD continues, the consequences for the agricultural economy — and even for our ability to feed ourselves — could be dire.

"No more Bees, No more Pollination, No more Plants, No more Animals, No more Man".

Although the low level exposures do not normally kill bees directly, they may impact some bee's ability to foraging for nectar, learn and remember where flowers are located, and possibly impair their ability to find their way home to the nest or hive. In April 2013, European Commission decided to introduce a 2-year moratorium in EU on the 3 neonicotinoid compounds—clothianidin, imidacloprid, and thiamethoxam—following reports by the European Food Safety Authority (EFSA) saying the substances pose an "acute risk" to honey bees essential to farming and natural ecosystems

IMPACT OF RADIATION FROM MOBILE PHONE TOWERS ON HUMAN BEINGS AND WILDLIFE

Health Impacts

- The surface area of bird is relatively larger than their body weight in comparison to human body so they absorb more radiation. Also the fluid content in the body of the bird is less due to small body weight so it gets heated up very fast. Magnetic field from the towers disturbs birds' navigation skills hence when birds are exposed to EMR they disorient and begin to fly in all directions. A large number of birds die each year from collisions with telecommunication masts.
- EMR may cause cellular and psychological changes in human beings due to thermal effects that are generated due to absorption of microwave radiation. The exposure can lead to genetic defects, effects on reproduction and development, Central Nervous System behaviour etc.
- EMR can also cause non thermal effects which are caused by radio frequency fields at levels too low to produce significant heating and are due to movement of calcium and other ions across cell membranes. Such exposure is known to be responsible for fatigue, nausea, irritability, headaches, loss of appetite and other psychological disorders.
- The current exposure safety standards are purely based on the thermal effects considering few evidences from exposure to non thermal effects.

What are the responsibilities of Stakeholders?

I. **MoEF** has to notify the impacts of communication towers on wildlife and human health to the concerned agencies for regulating the norms for notification of standards for safe limit of EMR.

II. **State/Local Bodies:** Regular monitoring and auditing in urban localities/ educational/hospital/ industrial/ residential/ recreational premises including the Protected Areas and ecologically sensitive areas. Carry out an '**Ecological Impact Assessment'** before giving permission for construction of towers in wildlife and ecologically important areas.

III. **State Environment and Forest Department** are entrusted with the task of providing regular awareness among the people about the norms on cell phone towers and dangers of EMR from them.

IV. **Department of Telecommunications:**

- Avoid overlapping of high radiation fields. New towers should not be permitted within a radius of one kilometer of the existing tower.
- The location and frequencies of cell phone towers and other towers emitting EMR should be made available in the public domain
- GIS mapping of all the cell phone towers to be maintained to monitor the population of bird and bees in and around

the wildlife protected area and the mobile towers.

- Need to refine the Indian standard on safe limits of exposure to EMR, keeping in view the available literature on impacts on various life forms
- To undertake Precautionary approaches to minimize the exposure levels and adopt stricter norms

V. **Other agencies** Any study conducted on impact of EMF radiation on wildlife needs to be shared to facilitate appropriate policy formulations

GENETICALLY ENGINEERED (GE) TREES

The proponents of biotechnology claim that trees that are genetically altered grow faster and yield better quality of wood in extreme temperatures. Thus they are a boon to forestry in dealing with climate change. First field trials of GE trees were started in Belgium in 1988, when researchers began to develop poplar trees that were herbicide resistant and that could grow faster. In 2002, China established commercial GE poplar trees plantation as a strategy to address the issue of deforestation. Latin American countries like Brazil and Argentina, the forerunners in GM food crops are also working on GE trees to enhance the production of pulp and paper.

Is GE trees safer than GM crops?

For: The proponents of the technology claim that GE trees are safer and there is no need to fear about negative consequences. Already the **UN has approved plantations of GE trees as carbon sinks under Kyoto Protocol's clean development** mechanism. With this stamp of approval, many countries would like to adopt the technology and establish GE plantations.

Against:

Environmentalists state that this technology poses as serious a threat as GM crops. The trees are perennial, that live longer than agricultural crops. The changes in the metabolism of trees may occur many years after they are planted, and trees are wild, undomesticated. This makes it difficult to decipher as to how the introduced gene will behave in natural environment. It has also been documented that the tree pollen travels a distance of more than 600 km. The probability that the GE tree pollen is likely to contaminate vast expanses of native forests with a wide variety of destructive traits may be a threat to ecological balance and the existing biodiversity of the tropical forests in global south. The contaminated pollen might pose threat to honey bees, adversely impacting pollination in the wild and on agriculture crops.

Who are behind developing GE trees and why?

ArborGen a subsidiary of Monsanto, oil companies like British Petroleum and Chevron that are investing in this technology. For these companies GE trees offer a viable alternate to fossil fuels as **GE trees could produce ethanol, a green fuel**. As the ethanol produced from food stocks came under attack, companies see bright future in non-food cellulose feedstock like GE tree

In INDIA The first experiment with genetically engineered tree was with rubber tree developed by the Rubber Research Institute in Kerala. **GE rubber are better adapted to drought resistance and increased environment stress tolerance**. Diverse forests were simplified by removal of multiple species and establishing monocultures that had commercial value. Already the country's landscape is scarred with millions of hectares of teak and eucalypts mono culture plantations. This approach has had negative consequences for the environment, biodiversity and local indigenous people. The same trend will be reinforced with the establishment of GE tree plantations, leading to further devastation of the natural environment and forests.

COST OF ENVIRONMENTAL DEGRADATION IN INDIA

The annual cost of environmental degradation in India is about Rs. 3.75 trillion, or 5.7% of India's 2009 gross domestic product (GDP), according to a report released by the World Bank. The impact of outdoor air pollution on GDP is the highest and accounts for 1.7% of the GDP loss, said the report. Indoor air pollution is the second-biggest offender and costs India 1.3% of GDP.

"The higher costs for outdoor/indoor air pollution are primarily driven by an elevated exposure of the young and productive urban population to particulate matter pollution that results in a substantial cardiopulmonary and chronic obstructive pulmonary disease (heart ailments) mortality load among adults," the report said. The study, titled **Diagnostic Assessment of Select Environmental Challenges in India**, A significant portion of diseases caused by poor water supply, sanitation and hygiene affect children younger than five, the report said. It ***attributed 23% of child mortality in the country to environmental degradation***. Following concept of growing economically now and cleaning up later won't be environmentally sustainable for the country in the long run, said the lead author of the report. The possible policy options to reduce particulate

matter pollution could be incentivizing technology upgradation, securing efficiency improvements, strengthening enforcement and enhancing technology and efficiency standards.

Steps taken by the Indian Government for control air pollution

- formulation of a Comprehensive Policy for Abatement of Pollution, • supply of improved auto–fuel,
- tightening of vehicular and industrial emission norms, • mandatory environmental clearance for specified industries,
- management of municipal, hazardous and bio-medical wastes, • promotion of cleaner technologies,
- strengthening the network of air quality monitoring stations,
- assessment of pollution load, and source apportionment studies,
- preparation and implementation of action plans for major cities & critically polluted areas, • Public awareness.

Biodiversity is defined as 'the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems'. - **United Nations Earth Summit (1992)**

THE RED DATA BOOK is a loose-leaf volume of information on the status of many kinds of species. This volume is continually updated and is issued by the **International Union for Conservation of Nature (IUCN)** located in Switzerland. The Red Data Book was first issued in 1966 by the IUCN's Special Survival Commission as a guide for formulation, preservation and management of species listed. In this Book, information for endangered mammals and birds are more extensive than for other groups of animals and plants, coverage is also given to less prominent organisms facing extinction. The pink pages in this publication include the critically endangered species. As status of the species changes, new pages are sent to the subscribers. Green pages are used for those species that were formerly endangered, but have now recovered to a point where they are no longer threatened. With passing time, the number of pink pages continue to increase. There are pitifully few green pages.

IUCN CLASSIFICATION OF CONSERVATION PRIORITY

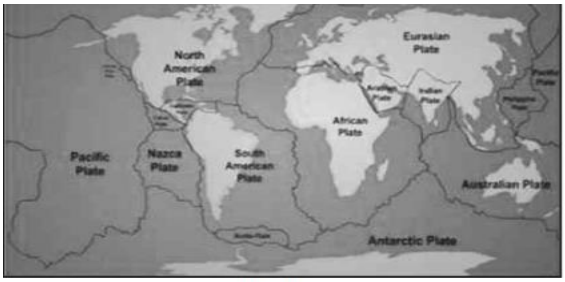
1) **Extinct (EX)** when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual.
2) **Extinct in the Wild (EW)** when it is known only to survive in cultivation, in captivity or as a naturalized population well outside the past range.
3) **Critically Endangered (CR)** when
   - reduction in population (> 90% over the last 10 years),
   - population size (number less than 50 mature individuals),
   - quantitative analysis showing the probability of extinction in wild in at least 50% in their 10 years)
4) **Endangered (EN)** when
   - reduction in population size (70% over the last 10 years),
   - population size estimated to number fewer than 250 mature individuals,
   - quantitative analysis showing the probability of extinction in wild in at least 20% within 20 years
5) **Vulnerable (VU)** when
   - reduction in population (> 50% over the last 10 years)
   - population size estimated to number fewer than 10,000 mature individuals,
   - probability of extinction in wild is at least 10% within 100 years,
6) **Near Threatened (NT)** when it has been evaluated against the criteria but does not qualify for Critically Endanger, Endangered or Vulnerable now, but is close to qualifying for a threatened category in the near future.
7) **Least Concern (LC)** when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
8) **Data Deficient (DD)** when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
9) **Not Evaluated (NE)** when it is has not yet been evaluated against the criteria.

INDIA REPRESENTS:

a) **Realms:** are large spatial regions within which ecosystems share a broadly similar biota. It is a continent or sub continent sized area with unifying features of geography and fauna & flora. The Indian region is composed of two realms. They are:

1) ***the Himalayan region represented by Palearctic Realm***

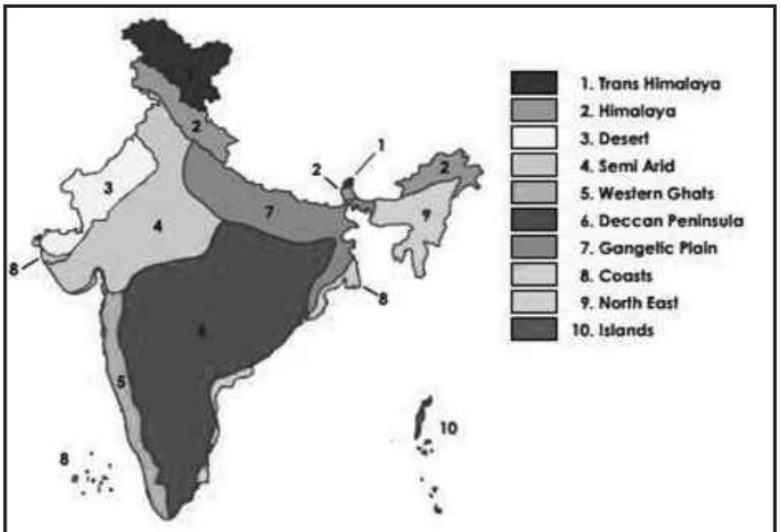
2) ***the rest of the sub-continent represented by Malayan Realm***



Realm

Eight terrestrial biogeographic realms are recognized.

1. Nearctic realm
2. Palearctic realm
3. Africotropical realm
4. Indo-Malayan realm
5. Ocenaia realm
6. Australian realm
7. Antarctic realm
8. Neotropical realm



Bio-geographic Zones India

b) **Biomes of India:** are the main groups of plants and animals living in areas of certain climate patterns. It includes the way in which animals, vegetation and soil interact together. The plants and animals living in the area are adapted to that environment. The five biomes of India are:

1) Tropical Humid Forests

2) Tropical Dry or Deciduous Forests (including Monsoon Forests)

3) Warm deserts and semi-deserts

4) Coniferous forests and

5) Alpine meadows

c) Biogeography deals with the geographical distribution of plants and animals. There are **10 Biogeographic zones** which are distinguished clearly in India. They are as follows—

1) **Trans-Himalayas**. An extension of the Tibetan plateau, harboring high-altitude cold desert in Laddakh (J&K) and Lahaul Spiti (H.P) comprising 5.7 % of the country's landmass.

2) **Himalayas**. The entire mountain chain running from north-western to northeastern India, comprising a diverse range of biotic provinces and biomes, 7.2 % of the country's landmass.

3) **Desert**. The extremely arid area west of the Aravalli hill range, comprising both the salty desert of Gujarat and the sand desert of Rajasthan. 6.9% of the country's landmass.

4) **Semi-arid**. The zone between the desert and the Deccan plateau, including the Aravalli hill range. 15.6 % of the country's landmass.

5) **Western ghats**. The hill ranges and plains running along the western coastline, south of the Tapti river, covering an extremely diverse range of biotic provinces and biomes. 5.8% of the country's landmass.

6) **Deccan peninsula**. The largest of the zones, covering much of the southern and southcentral plateau with a predominantly deciduous vegetation. 4.3 % of the country's landmass.

7) **Gangetic plain**. Defined by the Ganges river system, these plains are relatively homogenous. 11% of the country's landmass.

8) **North-east India**. The plains and non-Himalayan hill ranges of northeastern India, with a wide variation of vegetation. 5.2% of the country's landmass.

9) **Islands.** The Andaman and Nicobar Islands in the Bay of Bengal, with a highly diverse set of biomes. 0.03% of the country's landmass.

10) **Coasts.** A large coastline distributed both to the west and east, with distinct differences between the two; Lakshadweep islands are included in this with the percent area being negligible.

d) **Bio-geographic province (25)** is a ecosystematic or biotic subdivision of realms.

S.No.	Biogeographic Zones (10 nos)	Biogeographic Provinces (25 nos)
1.	Trans Himalaya	1A:Himalaya -Ladakh Mountains 1B: Himalaya -Tibetan Plateau 1C: Trans - Himalaya Sikkim
2.	The Himalaya	2A:Himalaya - North West Himalaya 2B: Himalaya - West Himalaya 2C: Himalaya - Central Himalaya 2D:Himalaya - East Himalaya
3.	The Indian Desert	3A: Desert – Thar 3B: Desert – Katchchh
4.	The Semi Arid	4A: Semi - Arid - Punjab Plains 4B: Semi - Arid - Gujarat Rajputana
5.	The Western Ghats	5A:Western Ghats - Malabar Plains 5B:Western Ghats -Western Ghats Mountains
6.	The Deccan Peninsula	6A: Deccan Peninsular - Central Highlands 6B: Deccan Peninsular - Chotta Nagpur 6C: Deccan Peninsular - Eastern Highlands 6D: Deccan Peninsular - Central Plateau 6E: Deccan Peninsular - Deccan South
7.	The Gangetic Plains	7A:Gangetic Plain - Upper Gangetic Plains 7B:Gangetic Plain - Lower Gangetic Plains
8.	The Coasts	8A: Coasts - West Coast 8B: Coasts - East Coast 8C: Coasts – Lakshdweep
9.	Northeast India	9A:North - East - Brahamputra Valley 9B: North - East – North East Hills
10.	Islands	10A: Islands – Andamans 10B: Islands – Nicobars

Floral endemism - order

1) peninsular India including western and Eastern Ghats (about 2,600 species),
2) Eastern Himalaya and north-eastern region (about 2,500 species),
3) north-western Himalaya (about 800 species)
4) Andaman & Nicobar Islands (about 250 species).

Crop genetic diversity The large mosaic of distinct agro-ecosystems, characterized by variations in edaphic, climatic and geographic features, has contributed to diverse cropping patterns and systems across the country.
India stand 7th in the world in terms of contribution of species to agriculture and animal husbandry. **The National Gene bank at National Bureau of Plant Genetic Resources (NBPGR), Delhi** is primarily responsible for conservation of unique accessions on long-term basis, as base collections for posterity, predominantly in the form of seeds.

Livestock genetic diversity In terms of population, India ranks first in buffaloes, second in cattle and goats, third in sheep, fourth in ducks, fifth in chicken and sixth in camels in the world. Over the years, animal husbandry has intensified in India with widespread introduction of exotic breeds. This has led to the reduction in total genetic variability and population size of many local breeds. ***(85%) of the domestic livestock in India is reared under low input production systems***.

India is the first nation in the world to have made provisions for environmental protection in the constitution. On 5th June 1972, the topic of the environment was first discussed as an issue at the U.N. Conference of Human Environment in Stockholm, and thereafter **5th June is celebrated as World Environment Day**. Soon after various acts were passed such as the Wildlife (Protection) Act 1972, Water (Prevention and Control of Pollution) Act 1974, Forest (Conservation) Act 1980, Air (Prevention and Control of Pollution) Act 1981, and subsequently Environment(Protection) Act 1986.

Wildlife Protection Act 1972

Forest and Wildlife come in Concurrent subject and both Parliament and State legislative assemblies can legislate on this subject. **In 1972,** these two subjects were in State List and so Parliament legislated the act under Article 312 where Rajya Sabha passes a resolution to give Parliament the power to legislate on State subjects. By the 42nd amendment, these two subjects were transferred to the Concurrent List. Before 1972, India had only 5 designated national parks.The Act provides for the protection of wild animals, birds, and plants; and for matters connected therewith or ancillary or incidental thereto. It extends to the whole of India.

An **amendment to the Act in 1982**, introduced a provision **permitting the capture and transportation of wild animals for the scientific management of the animal population**.

Constitutional Provisions for the Wildlife Act

- **Article 48-A**: "The State shall endeavor to **protect and improve the environment and to safeguard forest and wildlife** of the country". This article was added to the Constitution by the 42nd Amendment in 1976.

- **Article 51-A(g)**: "It shall be the **fundamental duty of every citizen of India to protect and improve the natural environment** including forests, lakes, rivers, and wildlife and to have compassion for living creatures".
- **Article 21**: **Right to a clean environment**.

Need for the Wildlife Protection Act

1. India is a treasure-trove of varied flora and fauna. Many species were seeing a rapid decline in numbers. For instance, it was mentioned by Edward Pritchard Gee (A naturalist), that at the turn of the 20th century, India was home to close to 40000 tigers. But, a census in 1972 showed this number drastically reduced to about 1827.
2. A drastic decrease in the flora and fauna can cause ecological imbalance, which affects many aspects of climate and the ecosystem.
3. The most recent Act passed during the British era in this regard was the Wild Birds and Animals Protection, 1935. This needed to be upgraded as the punishments awarded to poachers and traders of wildlife products were disproportionate to the huge financial benefits that accrue to them.
4. There were only five national parks in India prior to the enactment of this Act.

Schedules of the Wildlife Protection Act

Schedule I

- This Schedule covers **endangered species**.
- These species need rigorous protection and therefore, the **harshest penalties** for violation of the law are under this Schedule.
- Species under this Schedule are **prohibited to be hunted** throughout India, except under threat to human life.
- Absolute protection is accorded to species on this list.
- The **Trade of these animals is prohibited.**
- **Examples:** tiger, blackbuck, Himalayan Brown Bear, Brow-Antlered Deer, Blue whale, Common Dolphin, Cheetah, Clouded Leopard, hornbills, Indian Gazelle, etc.

Schedule II

- Animals under this list are also accorded **high protection**.
- **Their trade is prohibited**.
- They **cannot be hunted except under threat to human life.**
- **Examples:** Kohinoor (insect), Assamese Macaque, Bengal Hanuman langur, Large Indian Civet, Indian Fox, Larger Kashmir Flying Squirrel, Kashmir Fox, etc.

Schedule III & IV

- This **list is for species that are not endangered**.
- This includes protected species but the **penalty for any violation is less compared to the first two schedules**.
- **Hunting**: Not allowed.
- **Examples**: hyena, Himalayan rat, porcupine, flying fox, Malabar tree toad, etc.

Schedule V

- This **schedule contains animals that can be hunted**(**vermin**).
- **Examples**: mice, rats, common crow, fruit bats, etc.

Schedule VI

- This list contains **plants that are forbidden from cultivation**.
- **Examples**: pitcher plant, blue vanda, red vanda, kuth, etc.

Salient Features of Wildlife Protection Act

- The **Act provides for the formation of wildlife advisory boards, wildlife wardens, specifies their powers and duties, etc**.
- It helped India become a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**).
  - **CITES** is a multilateral treaty with the objective of **protecting endangered animals and plants.**
  - It is also known as the **Washington Convention** and was adopted as a result of a meeting of IUCN members.
- For the first time, a comprehensive list of the endangered wildlife of the country was prepared.
- The Act **prohibited the hunting of endangered species**.
- Scheduled animals are prohibited from being traded as per the Act's provisions.
- The Act provides for licenses for the sale, transfer, and possession of some wildlife species.
- It provides for the establishment of wildlife sanctuaries, national parks, etc.

- Its provisions paved the way for the formation of the **Central Zoo Authority**. This is the central body responsible for the oversight of zoos in India. It was established in 1992.
- The Act created **six schedules** that gave **varying degrees of protection** to classes of flora and fauna.
  - Schedule I and Schedule II (Part II) get absolute protection, and offenses under these schedules attract the maximum penalties.
  - The schedules also include species that may be hunted.
- The **National Board for Wildlife** was constituted as a **statutory organization** under the provisions of this Act.
  - This is an **advisory board** that offers advice to the central government on issues of wildlife conservation in India.
  - It is also the apex body to review and approve all matters related to wildlife, projects of national parks, sanctuaries, etc.
  - The chief function of the Board is to promote the conservation and development of wildlife and forests.
  - No alternation of boundaries in national parks and wildlife sanctuaries can be done without the approval of the NBWL.
  - It is **chaired by the Prime Minister**. It has 47 members including the Prime Minister. Among these, 19 members are ex-officio members. Other members include three Members of Parliament (two from Lok Sabha and one from Rajya Sabha), five NGOs, and 10 eminent ecologists, conservationists, and environmentalists.
- The Act also provided for the establishment of the **National Tiger Conservation Authority.**
  - It is a statutory body of the Ministry of Environment, Forest and Climate Change with an overall supervisory and coordination part, performing capacities as given in the Act.
  - Its mandate is to strengthen tiger conservation in India.
  - It gives statutory authority to **Project Tiger** which was launched in 1973 and has put the endangered tiger on a guaranteed path of revival by protecting it from extinction.

Reasons for migration

1. To avoid adverse factors (extreme climatic condition)
2. To manage food shortage
3. To manage shortage of water
4. To have a better breeding conditions
5. Less competition for safe nesting places

SPECIES EXTINCTION

- ***Deterministic processes*** that have a cause and effect. E.g. glaciations, human interference such as deforestation.
- ***Stochastic processes*** (chance and random events) that effect the survival and reproduction of individuals. E.g. unexpected changes of weather patterns, decreased food supply, disease, increase of competitors, predators or parasites, etc. that may act independently or add to deterministic effects.
- The impact of these processes will of course depend on the size and degree of genetic diversity and resilience of populations.
- Traits that adversely affect or increase a species vulnerability to extinction due to habitat fragmentation have been identified. These are: rarity or low abundance, poor dispersal ability, ecological specialization and unstable populations, high trophic status – as animals occupying a higher trophic level (i.e. the position of a species in a food chain) usually have smaller populations than those at lower levels (e.g. carnivores are fewer in number than herbivores), low adult survival rates, low intrinsic rate population increase, Body size, fecundity, dietary specialization.

PROTECTED AREAS (PA)

- The adoption of a National Policy for Wildlife Conservation in 1970 and the enactment of the Wildlife (Protection) Act in 1972 lead to a significant growth in the protected areas network, from 5 national parks and 60 sanctuaries to a network of 669 Protected Areas with geographical area of the country, 4.92%.
- The network was further strengthened by a number of national conservation projects, notably Project Tiger, project elephant, crocodile Breeding and Management Project, etc.

National Parks vs Wildlife Sanctuaries

Features of Wildlife Sanctuary

1. It is a natural area that is reserve by a governmental or private agency for the protection of particular species.
2. The area is designated for the protection of wild animals.
3. Only animals are conserved, Could be private property also, outside activities allowed.
4. **IUCN** has defined its Category IV type of protected areas.

Features of National Park:

1. Reserve area of land, owned by the government.
2. The area is protected from human exploitation, industrialization, and pollution.
3. No cutting, Grazing allowed, Outside Species Allowed
4. Conservation of 'wild nature' for posterity and as a symbol of national pride.
5. **International Union for Conservation of Nature (IUCN)**, and its **World Commission on Protected Areas**, has defined its Category II type of protected areas.

Declaration of the Protected Area by the State Government:

Initial Notification by the State ; Final Notification by State and at last approval by Central Notification.

Boundaries

- The notification shall specify, as nearly as possible, the situation and limits of such area.
- In cases where territorial waters is included, the limits shall be determined in consultation with the Chief Naval Hydrographer of the Central Government, after taking adequate measures to protect the occupational interests of the local fishermen.
- No alteration of boundaries of a sanctuary/National Park shall be made except on recommendation of the National Board for Wild Life.
- (The **Amendment Act of 1991 provided for the inclusion of territorial waters** in areas to be declared as sanctuaries for the protection of off-shore marine flora and fauna).

Settlement of rights

- The State Government shall make alternative arrangements required for making available fuel, fodder and other forest produce to the persons affected, in terms of their rights as per the Government records.
- The State Government appoints an officer as a 'Collector' under the Act to inquire into and determine the existence, nature and extent of rights of any person in or over the land comprised within the sanctuary/ National Park which is to be notified.
- After the issue of a notification for declaration of the Protected Area, no right shall be acquired in, on or over the land comprised within the limits of the area specified in such notification, except by succession, testamentary or intestate.

Claim of rights:

- In the case of a claim to a right in or over any land referred to, the Collector shall pass an order admitting or rejecting the same in whole or in part
- If such claim is admitted in whole or in part, the Collector may either (a) exclude such land from the limits of the proposed sanctuary or (b) proceed to acquire such land or rights, except where by an agreement between the owner of such land or holder of rights and the Government, the owner or holder of such rights has agreed to surrender his rights to the Government, in or over such land, and on **payment of such compensation, as is provided in the Land Acquisition Act, 1894**
(c) allow, in consultation with the Chief Wild Life Warden, the continuation of any right of any person in or over any land within the limits of the sanctuary

Entry into the Protected Area

- No person other than:-

1. A public servant on duty
2. A person who has been permitted by the Chief Wild Life Warden or the authorized officer to reside within the limits of the sanctuary/National Park
3. A person who has any right over immovable property within the limits of the sanctuary/National Park
4. A person passing through the sanctuary/National Park along a public highway
5. The dependents of the person referred to in clause (1), (2) or (3) above, Shall enter or reside in the sanctuary/National Park, except under and in accordance with the conditions of a permit granted.

Grant of permit for entry:

1) The Chief Wild Life Warden may, on application, grant to any person a permit to enter or reside in a sanctuary/ National Park for all or any of the following purposes:

- Investigation or study of wildlife and purposes ancillary or incidental thereto
- Photography / scientific research / tourism
- transaction of lawful business with any person residing in the sanctuary

2) The Chief Wild Life Warden shall be the authority who shall control, manage and maintain all Protected Areas.
3) The National Board for Wild Life may make recommendations on the setting up of and management of National Parks, Sanctuaries and other protected areas and on matters relating to restriction of activities in those areas.
4) The State Board for Wild Life shall advise the State Government on the selection and management of areas to be declared as protected areas.

CONSERVATION RESERVE AND COMMUNITY RESERVES are the outcome of Amendments to the Wild life protection act in 2003.

Conservation Reserves

- It is an area owned by the State Government adjacent to National Parks and sanctuaries for protecting the landscape, seascape and habitat of fauna and flora. It is managed through a **Conservation Reserve Management Committee**
- The State Government may, after having consultations with the local communities, declare any area owned by the Government as conservation reserve.
- Tiruppadaimarathur conservation reserve in Tirunelveli, Tamil Nadu is the first conservation reserve established in the Country. It is an effort of the village community to protect the birds nesting in their village and acted for declaration of conservation reserve.

Community Reserve

- The State Government may notify any community land or private land as a Community Reserve, provided that the members of that community or individuals concerned are agreeable to offer such areas for protecting the fauna and flora, as well as their traditions, cultures and practices.
- The declaration of such an area is aimed at improving the socio-economic conditions of the people living in such areas as well as conserving wildlife. The Reserve is managed through a **Community Reserve Management Committee**
- The State Government may, where the community or an individual has volunteered to conserve wildlife and its habitat, declare the area by notification as community reserve.
- No change in land use pattern shall be made within the Community Reserve, except in accordance with a resolution passed by the Management Committee and approval of the same by the State Government

COASTAL PROTECTED AREAS

- **Marine Protected Area (MPA)** as "any area of intertidal or sub tidal terrain, together with its overlaying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" - IUCN.
- MPA protects the vital life support processes of the sea and also ensures sustainable productivity and fish production. The MPAs in marine environment in India are primarily classified into following three categories:
- **Category-I**: covers National Parks and Sanctuaries and having entire areas in intertidal/sub-tidal or mangroves, coral reefs, creeks, seagrass beds, algal beds, estuaries, lagoons.
- **Category-II**: includes Islands, which have major parts in marine ecosystem and some part in terrestrial ecosystem.
- **Category-IIIA**: includes sandy beaches beyond intertidal line but occasionally interacting with the seawater
- **Category-IIIB**: includes ever green or semi ever green forests of Islands.
- MPAs in India comprise of a **33 national parks and wildlife sanctuaries designated under the Wildlife (Protection) Act, 1972**, encompassing a few of the country's richest coastal habitats.
- Marine National Park and Marine Sanctuary in the Gulf of Kutch form one unit (one MPA). Similarly Bhitarkanika National Park and Bhitarkanika Sanctuary are an integral part of one MPA. Thus, there a total of 31 MPAs in India.
- **MPAs cover less than 4.01 % of the total area of all Protected Areas of India**

SACRED GROVES OF INDIA comprise of patches of forests or natural vegetation – from a few trees to forests of several acres – that are usually dedicated to local folk deities. These spaces are protected by local communities because of their religious beliefs and traditional rituals that run through several generations. The degree of sanctity of the sacred forests varies from one grove to another. In some forests even the dry foliage and fallen fruits are not touched.

Threats to the Sacred Groves

- Disappearance of the traditional belief systems
- rapid urbanization and developmental interventions
- 'Sanskritisation' or the transformation of the primitive forms of nature worship into formal temple worship.
- Invasion by exotic weeds such as Eupatorium odoratum, Lantana camara and Prosopis juliflora
- Pressures due to increasing livestock and fuelwood collection.

EXPORT - PROHIBITED GOODS

- All wild animals, animal articles including their products and derivatives (excluding those for which ownership certificates have been granted and also those required for transactions for education, scientific research and management under Wild Life (Protection) Act, 1972 including their parts and products).
- Beef of cows, oxen and calf. Beef in the form of offal of cows, oxen and calf
- Meat of buffalo (both male and female) fresh and chilled and frozen
- Peacock Tail Feathers & its Handicrafts and articles
- Shavings & Manufactured Articles of shavings of Shed Antlers of Chital and Sambhar
- Sea shells, Wood and wood products, Fuel wood and Wood charcoal, Mechanical, chemical and semi chemical wood pulp
- Sandalwood in any form,(but excluding finished handicraft products of sandalwood, machine finished sandalwood products, sandalwood oil):
- Red Sanders wood, Value added products of Red Sanders

THE MAN AND BIOSPHERE (MAB) is an Intergovernmental Scientific Programme aiming to set a scientific basis for the improvement of the relationships between people and their environment globally.

- Launched in the early 1970s, it proposes an interdisciplinary research agenda and capacity building that target the ecological, social and economic dimensions of biodiversity loss and the reduction of this loss.
- The agenda of the MAB Prorgamme is defined by its main governing body, **the International Coordinating Council** in concertation with the broader MAB Community.
- For implementation of its interdisciplinary work on ground, MAB relies on the World Network of Biosphere Reserves, and on thematic networks and partnerships for knowledge-sharing, research and monitoring, education and training, and participatory decision making.
- It predicts the consequences of today's actions on tomorrow's world and thereby increases people's ability to efficiently manage natural resources for the well-being of both human populations and the environment.

BIOSPHERE RESERVE (BR) The **International Co-ordinating Council (ICC) of UNESCO**, November, 1971, introduced the designation 'Biosphere Reserve' for natural areas. The concept of Biosphere Reserves was refined by a Task Force of UNESCO's MAB Programme in 1974, and BR network was formally launched in 1976.

- BR is an international designation by UNESCO for representative parts of natural and cultural landscapes extending over large area of terrestrial or coastal/marine ecosystems or a combination thereof.
- As places that seek to reconcile conservation of biological and cultural diversity and economic and social development through partnerships between people and nature, they are ideal to test and demonstrate innovative approaches to sustainable development from local to international scales.

National Biosphere Reserve Programme was initiated in 1986 to ensure participation of local inhabitants for effective management and devise means of improving livelihood of the local inhabitants through sustainable use.

- It may be noted that BRs are not a substitute or alternative, but a re-enforcement to the existing protected areas. The objectives of the ***Biosphere Reserve programme, as envisaged by the Core Group of Experts***, are as follows*:*

1) To conserve the diversity and integrity of plants and animals within natural ecosystems;
2) To safeguard genetic diversity of species on which their continuing evolution depends;
3) To provide areas for multi-faceted research and monitoring;
4) To provide facilities for education and training;
5) To ensure sustainable use of natural resources through most appropriate technology for improvement of economic well-being of the local people.

These objectives should be oriented in such a way that ***BRs are the Units wherein the Biological, socio-economic and cultural dimension of conservation are integrated together into a realistic conservation strategy***.

Criteria for selection of BRs as laid down by the **Core Group of Experts in 1979** are listed below:

Primary criteria

- A site that must contain an effectively protected and minimally disturbed core area of value of nature conservation and should include additional land and water suitable for research and demonstration of sustainable methods of research and management.
- The core area should be typical of a biogeographical unit and large enough to sustain viable populations representing all tropic levels in the ecosystem.

Secondary criteria

- Areas having rare and endangered species
- Areas having diversity of soil and micro-climatic conditions and indigenous varieties of biota.
- Areas potential for preservation of traditional tribal or rural modes of living for harmonious use of environment.

Structure and Design of Biosphere Reserves

1) **The Core Zone:** should be kept absolutely undisturbed. It must contain suitable habitat for numerous plant and animal species, including higher order predators and may contain centres of endemism. A core zone secures legal protection and management and research activities that do not affect natural processes and wildlife are allowed. Strict nature reserves and wilderness portions of the area are designated as core areas of BR. The core zone is to be kept free from all human pressures external to the system.
2) **The Buffer Zone:** adjoins or surrounds core zone. Its uses and activities are managed in ways that protect the core zone. These uses and activities include restoration, demonstration sites for enhancing value addition to the resources, limited recreation, tourism, fishing and grazing, which are permitted to reduce its effect on core zone. Research and educational activities are to be encouraged. Human activities, if natural within BR, are likely to be permitted to continue if these do not adversely affect the ecological diversity.
3) **The Transition Zone:** is the outermost part of a Biosphere Reserve. This is usually not delimited one and is a zone of cooperation where conservation, knowledge and management skills are applied and uses are managed in harmony with the purpose of the Biosphere Reserve. This includes settlements, crop lands, managed forests and area for intensive recreation, and other economic uses characteristic of the region.

In Buffer Zone and the Transition Zones, manipulative macro-management practices are used. Experimental research areas are used for understanding the patterns and processes in the ecosystem. Modified or degraded landscapes are included as rehabilitation areas to restore the ecology in a way that it returns to sustainable productivity.

How Biosphere Reserves are different from protected areas?

- BR is not intended to replace existing protected areas but it widens the scope of conventional approach of protection and further strengthens the Protected Area Network.
- Existing legally protected areas (National Parks, Wildlife Sanctuary, Tiger Reserve and reserve/protected forests) may become part of the BR without any change in their legal status.
- On the other hand, inclusion of such areas in a BR will enhance their national value.

International Day for Biological Diversity - 22 May,2010 the UN General Assembly adopted 22 May as IDB, to commemorate the adoption of the text of the Convention on 22 May 1992 by the **Nairobi Final Act of the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity.**

However, the Biosphere Reserves differ from protected areas due to their emphasis on:

1) Conservation of overall biodiversity and landscape, rather than some specific flagship species, to allow natural and evolutionary processes to continue without any hindrance.
2) Different components of BRs like landscapes, habitats, and species and land races.
3) Developmental activities, and resolution/mitigation of conflicts between development and conservation,
4) Increase in broad-basing of stakeholders, especially local people's participation and their Training, compared to the features of scheme on Wildlife Sanctuaries and National Parks.
5) Sustainable environment friendly development, and sustained coordination amongst different development organizations and agencies.

6) Research and Monitoring to understand the structure and functioning of ecological system and their mode of reaction when exposed to human intervention.

- **The Indian National Man and Biosphere Committee**. identifies new sites, advises on policies and programmes, lays down guidelines, reviews progress and guidelines in the light of evaluation studies and feedback.
- The **Management of BRs is the responsibility of the concerned State/UT** with necessary financial assistance, guidelines for management and Technical expertise provided by the Central Government.
- **BR are internationally recognized within the framework of UNESCO's Man and Biosphere (MAB) programme**, after receiving consent of the participating country

BIODIVERSITY HOT SPOTS concept was put forth by **Norman Myers in 1988**

- To qualify as a hot spot, a region must meet two strict criteria:

a. Species endemism - it must contain at least 1,500 species of vascular plants (> 0.5% of the world's total) as endemics, and
b. Degree of threat - it has to have lost at least 70% of its original habitat.

- Over 50% of the world's plant species and 42% of all terrestrial vertebrate species are endemic to the 35 biodiversity hot spots.

The 8 hottest hot spots in terms of five factors

1. Madagascar 2. Philippines 3. Sundaland 4. Brazil's Atlantic Forest 5. Caribbean 6. Indo-Burma 7. Western Ghats/Sri Lanka 8. Eastern Arc and Coastal Forests of Tanzania/Kenya

Indian Biodiversity Hot Spots

1) **The Eastern Himalayas Hot Spot** is the region encompassing Bhutan, northeastern India, and southern, central, and eastern Nepal. The region is geologically young and shows high altitudinal variation. The abrupt rise of the Himalayan Mountains from less than 500m to more than 8,000m results in a diversity of ecosystems that range from alluvial grasslands and subtropical broad leaf forests along the foothills to temperate broad leaf forests in the mid hills, mixed conifer and conifer forests in the higher hills, and alpine meadows above the tree line.

2) **Indo-Burma Region:** is spread out from Eastern Bangladesh to Malaysia and includes North-Eastern India south of Brahmaputra river, Myanmar, the southern part of China's Yunnan province, Lao People's Democratic Republic, Cambodia, Vietnam and Thailand.

3) **Western Ghats and Sri Lanka:** Western Ghats, also known as the "Sahyadri Hills" encompasses the mountain forests in the southwestern parts of India and highlands of southwestern Sri Lanka. The entire extent of hotspot was originally about 1,82,500 sq.km , but due to tremendous population pressure, now only 12,445 sq.km or 6.8% is in pristine condition. The wide variation of rainfall patterns in the Western Ghats, coupled with the region's complex geography, produces a great variety of vegetation types. These include scrub forests in the low-lying rain shadow areas and the plains, deciduous and tropical rainforests up to about 1,500m, and a unique mosaic of montane forests and rolling grasslands above 1,500m. In Sri Lanka diversity includes dry evergreen forests to dipterocarpus dominated rainforests to tropical montane cloud forest.

PROJECT TIGER The fall and rise in the number of Tiger population in India is an index of the extent and nature of conservation efforts. It is estimated that India had about 40,000 tigers in 1900, and the number declined to a mere about 1800 in 1972. Hence, Project Tiger centrally sponsored scheme was launched in 1973 with the following objectives:

- To ensure maintenance of available population of Tigers in India for scientific, economic, aesthetic, cultural and ecological value
- To preserve, for all times, the areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people

The scientific name for the tiger is Panthera Tigris. There are 8 subspecies of tiger: among them at present only 5 subspecies are present in the wild. They are – **Bengal, South China, Indo-Chinese, Sumatran, and Siberian**. 3 subspecies of tiger—Caspian, Bali, and Javan—are extinct.

Tiger Reserve are areas that are notified for the protection of the tiger and its prey, and are governed by Project Tiger which was launched in the country in 1973. Initially 9 tiger reserves were covered under the project, and has currently increased to 42, falling in 17 States (tiger reserve States). The State Government shall, on recommendation of the **National Tiger Conservation Authority**, notify an area as a tiger reserve.

National Tiger Conservation Authority (NTCA): The Amendment Act of 2006 provides for the constitution of a statutory authority NTCA to aid in the implementation of measures for the conservation of the tiger.

Powers and functions:

1. To approve the Tiger Conservation Plan prepared by the State Government
2. To evaluate and assess various aspects of sustainable ecology and disallow any ecologically unsustainable land use such as mining, industry and other projects within tiger reserves
3. To lay down normative standards for tourism activities and guidelines for project tiger from time to time for tiger conservation in the buffer and core area of tiger reserves and ensure their due compliance
4. To provide information on protection measures including future conservation plan, estimation of population of tiger and its natural prey species, status of habitats, disease surveillance, mortality survey, patrolling, reports on untoward happenings and such other management aspects as it may deem fit including future plan of conservation
5. To ensure that tiger reserves and areas linking on protected area or tiger reserve with another protected area or tiger reserve are not diverted for ecologically unsustainable uses, except in public interest and with the approval of the National Board for Wild Life.
6. To facilitates and support tiger reserve management in the State for biodiversity conservation initiatives through eco-development and peoples participation as per approved management plans, and to support similar initiatives in adjoining areas consistent with the Central and State laws
7. To ensure critical support including scientific, information technology and legal support for better implementation of the tiger conservation plan
8. To facilitate ongoing capacity building program for skill development of officers and staff of tiger reserves

"Phase IV"

- This initiated intensive, annual monitoring of tigers at the tiger reserve level, across protected areas in the country, from November 2011.
- The methodology is developed by the Wildlife Institute of India (WII) and the National Tiger Conservation Authority (NTCA), in consultation with experts, and will use statistically sound procedures to estimate numbers of both tigers and their prey.
- The tiger monitoring protocol use camera traps, at a density of 25 double-sided cameras per 100 square kilometres, and a minimum trapping effort of 1000 trap nights per 100 square kilometres.
- This will provide a yearly indication of the status of critical tiger populations around the country, and will be critical to long-term management and conservation of tiger populations.
- Prey population monitoring will be conducted simultaneously, using Distance sampling protocols. Distance sampling will be conducted along line transects already established in phase I, and will use a minimum of 30 spatial replicates for 2 km each, and a total effort of 300 km.

The estimated tiger population in 2006 was 1411 and due to conservation efforts it has steadily increased and the tiger population was 1706 in the 2010 tiger estimate.

International Cooperation

- India has a MoU with Nepal on controlling trans-boundary illegal trade in wildlife and conservation, apart from a protocol on tiger conservation with China. The process is on for bilateral protocol with Bangladesh, Bhutan & Myanmar.
- A Global Tiger Forum of Tiger Range Countries has been created for addressing international issues related to tiger conservation.

Asian Ministerial Conference on Tiger Conservation

The New Delhi Resolution on Tiger Conservation was adopted by the 3rd Asian Ministerial Conference on Tiger Conservation.

- Recovery of tiger in low density protected areas by **3Rs – Restoration, Reintroduction and Rehabilitation**, acceleration of the implementation of ***Global Tiger Recovery Programme***, which includes habitat improvement and anti-poaching surveillance through modern technology, align development and tiger conservation by ensuring intensive participation of locals and other stakeholders, promotion of tiger habitats to provide ecosystem service, economic growth and addressing climate change and strengthening cooperation to combat wildlife crime.
- This is the third conclave, with the earlier ones being held at Hua Hin, Thailand (2010) and Thimpu, Bhutan (2012), besides the Tiger Summit at St Petersburg in 2010. Tiger Range Countries include Bangladesh, Bhutan, Cambodia, China, Indonesia, India, Lao PDR, Malaysia, Myanmar, Nepal, Russian Federation, Thailand, Vietnam.

PROJECT ELEPHANT was **launched in February, 1992** as centrally sponsored scheme to assist states having free ranging populations of wild elephants and to ensure long term survival of identified viable populations of elephants in their natural habitats. The Project is being mainly implemented **in 13 States** / UTs , viz. Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. Small support is also being given to Maharashtra and Chhattisgarh.

- States are being given financial as well as technical assistance in achieving the objectives of the Project. Help is also provided to other states with small populations of elephants for the purpose of census, training of field staff and mitigation of human-elephant conflict.

Aim

- Ecologically restoring the natural habitats and migratory routes of the elephants
- Mitigation of the increasing conflicts between man and elephants in important habitats and moderating the pressures of human and domestic stock activities in important elephant habitats.
- Developing scientific and planned management measures for conservation of elephants.
- Protecting the elephants from poachers and other unnatural causes of death and preventing illegal ivory trade
- Researching on issues related to elephants and creating public awareness and education programs for it.
- Eco-development, Veterinary care for the elephants. and breeding of tamed elephants.

Elephant Corridor is defined as a stretch/ narrow strips of forested (or otherwise) land that connects larger habitats with elephant populations and forms a conduit for animal movement between the habitats. This movement helps enhance species survival and birth rate. There are **88 identified elephant corridors in India**. Out of total 88 corridors, 20 were in south India, 12 in north-western India, 20 in central India, 14 in northern West Bengal and 22 in north-eastern India.

- **77.3% is regularly used by elephants**. About 1/3 is of ecologically high priority and remaining 2/3 of medium priority.
- In south India, 65% of the corridors are in protected area or in reserved forests. 90% in central India are jointly under forest, agriculture and settlements, Only 10% are completely under forest area.
- Nationally, ***only 24% of the corridors are under complete forest cover.***

Threats to Elephant Corridors

- The primary threat is the Habitat loss leading to fragmentation and destruction caused by developmental activities like construction of buildings, roads, railways, holiday resorts and the fixing solar energized electric fencing, etc.
- Coal mining and iron ore mining is the two "single biggest threats" to elephant corridors in central India.
- Orissa, Jharkhand and Chhattisgarh, are mineral-rich states, but also have the highest number of elephant corridors in the country, which makes them known for elephant-man conflicts.
- There is also a serious poaching problem, as elephant ivory from the tusks is extremely valuable.
- Elephants need extensive grazing grounds and most reserves cannot accommodate them.

If protected areas are not large enough, elephants may search for food elsewhere. This often results in conflicts with humans, due to elephants raiding or destroying crops.

Mitigation

- Fusion of the corridors with nearby protected areas wherever feasible; in other cases, declaration as Ecologically Sensitive Areas or conservation reserves to grant protection.
- During the process of securing a corridor, monitoring for animal movement have to be carried out; depending on the need, habitat restoration work shall also be done.
- Securing the corridors involves sensitizing local communities to the option of voluntarily relocation outside the conflict zones to safer areas. It would also have great conservation value, preventing further fragmentation of the continuous forest habitat by encroachment from urban areas, as well as providing continued refuge for birds and animals .

Monitoring of Illegal Killing of Elephants (MIKE) Programme

- Mandated by COP resolution of CITES, MIKE program **started in South Asia in the year 2003** with following purpose –
- To provide information needed for elephant range States to make appropriate management and enforcement decisions, and to build institutional capacity within the range States for the long-term management of their elephant populations

Main objectives

1. to measure levels and trends in the illegal hunting of elephants;
2. to determine changes in these trends over time; and
3. to determine the factors causing or associated with such changes, and to try and assess in particular to what extent observed trends are a result of any decisions taken by the Conference of the Parties to CITES

- Under the programme data are being collected from all sites on monthly basis in specified MIKE patrol form and submited to **Sub Regional Support Office for South Asia Programme located in Delhi** who are assisting Ministry in the implementation of the programme.

Haathi Mere Saathi is a campaign launched by the Ministry of environment and forest (MoEF) in partnership with the wildlife trust of India (WTI) to improve conservation and welfare prospects of the elephant - India's National Heritage Animal.

- The campaign was launched at the "Elephant- 8" Ministerial meeting held in Delhi on 24th May 2011.
- The E-8 countries comprise of India, Botswana, the Republic of Congo, Indonesia, Kenya, Sri Lanka, Tanzania, and Thailand.
- This public initiative was aimed at increasing awareness among people and developing friendship, companionship between people and elephants.
- The campaign focuses on various target audience groups including locals near elephant habitats, youth, policy makers, among others.
- It envisions setting up of Gajah (the elephant) centres in elephant landscapes across the country to spread awareness on their plight and invoke people's participation in addressing the threats to them.
- It also plants to build capacity of protection and law enforcement agencies at the ground level, and advocate for policies favouring the pachyderms (the elephant).
- Recommended by the elephant task force (ETF) constituted by the ministry last year, the campaign to "Take Gajah (the elephant) to the prajah (the people)" aims to spread awareness and encourage people's participation in elephant conservation and welfare. **Tiger, faces threat of extinction, whereas the elephant faces threat of attrition**. The elephant Nos. have not increased or decreased drastically but there is a increasing pressure on the elephant habitats and it is a serious concern which has to be addressed by involving people in elephant conservation and welfare through this campaign.
- The Asian elephant is threatened by habitat degradation, conflicts and poaching for ivory. These threats are more intense in India which harbours more than 50% of worlds Asian elephant population.
- India has about 25000 elephants in the wild. Despite this seemingly large number, the elephant particularly the tuskers (male), in India is as threatened as the tiger. There are just about 1200 tuskers left in the country.
- The E-8 countries besides resolving to take necessary steps in the direction of elephant conservation also decided to actively pursue a common Agenda to ensure a long term welfare and survival of all species of elephants in all range countries.
- To realise this global goal, the meeting has called upon all range countries to join hands under the umbrella of elephant-50:50 forum. It is the shared vision of 50 states to promote conservation, management and welfare of elephants in the next 50 years.
- The E-8 countries decided to hold the **1st International Congress of E-50:50 forum in early 2013 at New Delhi**, India for adopting a common global vision on conservation, management and welfare of elephants across all range countries.

Indian Rhino Vision 2020 implemented by the Department of Environment and Forests, Assam with The Bodo autonomous council as a active partner. The programme will be supported by WWF – India, WWF areas (Asian rhino and elephant action strategy) programme, the **International Rhino foundation (IRF)**, save the rhino's campaign of zoological institutions worldwide and a number of local NGOs.

- The vision of this program is to increase the ***total rhino foundation in Assam from about 2000 to 3000 by the year 2020*** and to ensure that these rhinos are distributed over at least 7 protected areas (PA) to provide long term viability of the one-horned rhino population.

GREEN HOUSE GASES means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorbs and re-emit infrared radiation. **Water vapour** is the biggest overall contributor to the greenhouse effect .Since the rate of evaporation rises with temperature, the amount of water vapour in the air at any one time (and the amount of warming it causes) is strongly related to the amount of other greenhouse gases in the air.

METHANE

• Wetlands are the largest source, emitting CH_4 from bacteria that decompose organic materials in the absence of oxygen.

• Smaller sources include termites, oceans, sediments, volcanoes, and wildfires.
• ***Agriculture***: Domestic livestock such as cattle, buffalo, sheep, goats, and camels produce large amounts of CH_4 as part of their normal digestive process. Also, when animals' manure is stored or managed in lagoons or holding tanks, CH_4 is produced. Because humans raise these animals for food, the emissions are considered human-related. Globally, the Agriculture sector is the primary source of CH_4 emissions
• ***Industry***: Methane is the primary component of natural gas. Some amount of CH_4 is emitted to the atmosphere during the production, processing, storage, transmission, and distribution of crude oil & natural gas.
• ***Waste from Homes and Businesses***: Methane is generated in landfills as waste decomposes and from the treatment of wastewater.

NITROUS OXIDE

• Natural emissions of N_2O are mainly from bacteria breaking down nitrogen in soils and the oceans.
• ***Agriculture***. Nitrous oxide is emitted when people add nitrogen to the soil through the use of synthetic fertilizers. Nitrous oxide is also emitted during the breakdown of nitrogen in livestock manure and urine, which contributed to 6% of N_2O emissions in 2010.
• ***Transportation***. Nitrous oxide is emitted when transportation fuels are burned.
• ***Industry***. Nitrous oxide is generated as a byproduct during the production of nitric acid, which is used to make synthetic commercial fertilizer, and in the production of adipic acid, which is used to make fibers, like nylon, and other synthetic products.

• ***Removal***: Nitrous oxide is removed from the atmosphere when it is absorbed by certain types of bacteria or destroyed by ultraviolet radiation or chemical reactions.

FLUORINATED GASES

• They are emitted through a variety of industrial processes such as aluminum and semiconductor manufacturing & Substitution for Ozone-Depleting Substances.
• Many fluorinated gases have very high global warming potentials (GWPs) relative to other greenhouse gases. Fluorinated gases are well-mixed in the atmosphere, spreading around the world after they're emitted.
• Fluorinated gases are removed from the atmosphere only when they are destroyed by sunlight in the far upper atmosphere. In general, fluorinated gases are the most potent and longest lasting type of GHG emitted by human activities.
• There are three main categories of fluorinated gases—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

BLACK CARBON is a solid particle or aerosol, commonly known as soot, is a form of particulate air pollutant, produced from incomplete combustion. It consists of pure carbon in several linked forms. Sources are biomass burning, cooking with solid fuels, and diesel exhaust, etc.

What does BC do?

• Black carbon warms the Earth by absorbing heat in the atmosphere and by reducing albedo, (the ability to reflect sunlight) when deposited on snow and ice.
• BC is the strongest absorber of sunlight and heats the air directly. In addition, it darkens snow packs and glaciers through deposition and leads to melting of ice and snow.
• Regionally, BC disrupts cloudiness and monsoon rainfall and accelerates melting of mountain glaciers such as the Hindu Kush-Himalayan glaciers.

Life time Black carbon stays in the atmosphere for only several days to weeks. Thus the effects of BC on the atmospheric warming and glacier retreat disappear within months of reducing emissions.

How far India contributes to globe? According to estimates, between 25 and 35% of black carbon in the global atmosphere comes from China and India, emitted from the burning of wood and cow dung in household cooking and through the use of coal to heat homes.
Government Measures Project Surya has been launched to reduce black carbon in atmosphere by introducing efficient stove technologies, solar cookers, solar lamps and biogas plants.

Brown Carbon is a ubiquitous and unidentified component of organic aerosol which has recently come into the forefront of atmospheric research.

• Light-absorbing organic matter (other than soot) in atmospheric aerosols of various origins, e.g., soil humics, humic-like substances (HULIS), tarry materials from combustion, bioaerosols, etc.

• "Brown carbon" is generally referred for greenhouse gases and "black carbon" for particles resulting from impure combustion, such as soot and dust.

How to estimate the effect of each gas? **Each gas's effect on climate change depends on three main factors:**

1) *How much of these gases are in the atmosphere?*
2) *How long do they stay in the atmosphere?*
3) *How strongly do they impact global temperatures?*

GLOBAL WARMING POTENTIAL describes the impact of each gas on global warming. The two most important characteristics of a GHG in terms of climate impact are **how well the gas absorbs energy (preventing it from immediately escaping to space), and how long the gas stays in the atmosphere.**

• The Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.

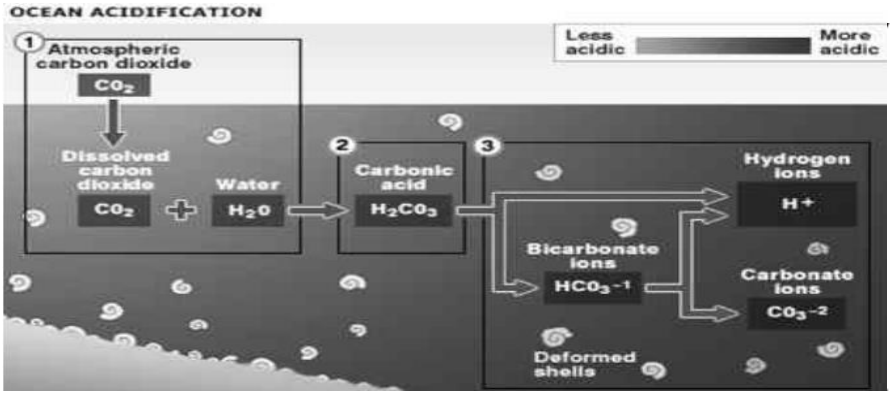
RECEDING GLACIERS-A SYMPTOM OF GLOBAL CLIMATE CHANGE

• 150 years ago there were 147 glaciers in Glacier National park, but today only 37 glaciers remain, and scientists predict that they are likely to melt by the year 2030. Similarly, glaciers all across the Himalayas and Alps are retreating and disappearing every year. There are almost 160,000 glaciers found in Polar Regions and high mountain environments. Therefore, researchers are increasingly using satellite remote sensors to routinely survey our world's glaciers in a fraction of the time.

OCEAN ACIDIFICATION Oceans are an important reservoir for CO_2, absorbing a significant quantity of it (one-third) produced by anthropogenic activities and effectively buffering climate change. Ocean acidification is the change in ocean chemistry - lowering of ocean pH driven by the uptake of carbon compounds by the ocean from the atmosphere. As the uptake of atmospheric carbon dioxide by the ocean increases, the concentration of hydrogen ions in the ocean increases, the concentration of carbonate ions decreases, the pH of the oceans decreases and the oceans become less alkaline.

The uptake of atmospheric carbon dioxide is occurring at a rate exceeding the natural buffering capacity of the ocean. The pH of the ocean surface waters has decreased by about 0.1 pH unit (i.e. 26% increase in ocean hydrogen ion concentration) since the beginning of the industrial revolution. The **ocean currently has a pH around 8.0** and is therefore 'basic' and it is nearly impossible, chemically, for all of it to actually become a pH less than 7.0.

Effect of ocean acidification Increases in atmospheric CO_2 levels lead to decrease in pH level, increase in the concentration of carbonic acid and bicarbonate ions, causing **a decrease in the concentration of carbonate ions**. Thus carbonate ions are less available and calcification is therefore harder to achieve, and may be prevented altogether.



Forms of calcium carbonate

Calcite and aragonite are two different forms of calcium carbonate.

1. Calcite is the mineral form found in the shells of planktonic algae, amoeboid protists, some corals, echinoderms, and some molluscs (e.g. oysters); it is relatively less soluble.
2. Aragonite is a more soluble form of calcium carbonate; it is found in most corals, most mollusks (small planktonic snails), as well as some species of algae.

Mitigation • Reducing CO_2 • promoting government policies to cap CO_2 emissions, • eliminate offshore drilling,

• by advocating for energy efficiency and • Alternative energy sources such as wind power, solar, etc.

Saturation horizon is the level below which calcium carbonate minerals undergo dissolution.

• Deep, cold ocean waters are naturally under saturated with carbonate ions causing the shells of most calcifying organisms to dissolve. Surface waters are over saturated with carbonate ions and do not readily dissolve shells of calcifying organisms.

• Those organisms that can survive below the saturation horizon do so due to special mechanisms to protect their calcium carbonate from dissolving. As ocean acidification causes this horizon to rise vertically in the water column so more and more

calcifying organisms will be exposed to under saturated water and thus vulnerable to dissolution of their shells and skeletons.

- The saturation horizon of calcite occurs at a greater ocean depth than that for aragonite, but both horizons have moved closer to the surface presently when compared to the 1800s.

Ocean acidification and the short and long-term fate of carbon in the system

On long timescales (>100,000 years) there is a natural balance maintained between the up-take and release of CO_2 on Earth; the CO_2 produced by volcanoes, the main natural source of CO_2, is taken up by the production of organic matter by plants and by rock weathering on land. However, rock weathering takes tens of thousands of years so will not remove the current anthropogenic input of CO_2 to the atmosphere and ocean fast enough.

On shorter time scales (>1,000 years), the ocean has an internal stabilizing feedback linking the ocean carbon cycle to the underlying carbonate rich sediment known as carbonate compensation. The upper layers of the ocean tend to be supersaturated with $CaCO_3$, so little dissolution takes place, whilst the deep ocean is undersaturated and carbonate readily dissolves. The first boundary between these two states is known as the **lysocline**, the depth at which dissolution strongly increases in the deep ocean. The $CaCO_3$ in the form of dead shells sink to the sea bed. If it is of shallow water depth, the majority is buried in the sediment and trapped for a long time, but where the shells sink in deep water nearly all the $CaCO_3$ is dissolved, thereby not locking the carbon away for millions of years. The current increased rate of dissolution of atmospheric CO_2 into the ocean results in an imbalance in the **carbonate compensation depth (CCD**), the depth at which all carbonate is dissolved. As the pH of the ocean falls, it results in a shallowing of the lysocline and the CCD, thus exposing more of the shells trapped in the sediments to undersaturated conditions causing them to dissolve, which will help buffer ocean acidification but over a long time scale of a 1000 years.

Ozone(O_3) in the troposphere is "bad" because it dirties the air and helps to form smog, which is not good to breathe. Ozone in the stratosphere is "good" because it protects life on Earth by absorbing some of the sun's harmful (UV) rays. The UV rays cause direct damage to the genetic material or DNA of animal and plant cells.

OZONE DEPLETION The rate at which ozone is being destroyed is much faster than the rate at which it is being formed. The best example of such an Ozone Depletion is the atmosphere over the Antarctic which has only about 50% of the ozone that originally occurred there. The actual realization of ozone-depletion came only in 1985.

Sources

Chlorofluorocarbons (CFCs): They are used as refrigerants, propellents in aerosol sprays, foaming agents in plastic manufacturing, fire extinguishing agents, solvents for cleaning electronic and metallic components, for freezing foods etc . Two-thirds of CFC is used as refrigerants while one-third is used as blowing agents in foam insulation products.

Why CFCs are used? CFCs has a wide and varied application due to its properties like non-corrosiveness, non-inflammability, low toxicity and chemical stability, etc.

Lifetime & removal of CFCs Unlike other chemicals, CFCs cannot be eliminated from the atmosphere by the usual scavenging processes like photodissociation, rain-out and oxidation. In fact, the residence time of CFCs in the atmosphere estimated to be between 40 and 150 years. During this period, the CFCs move upwards by random diffusion, from the troposphere to the stratosphere.

The escape of CFCs The CFCs enter into the atmosphere by gradual evaporation from their source. CFCs can escape into the atmosphere from a discarded refrigerator. Since the CFCs are thermally stable they can survive in the troposphere. But in the stratosphere, they are exposed to UV radiation.

The chemical reaction The molecules of CFCs when exposed to UV radiation break up, thus freeing chlorine atoms. A free chlorine atom reacts with an ozone molecule to form chlorine monoxide (ClO). The molecules of chlorine monoxide further combine with an atom of oxygen. This reaction results in the formation of an oxygen molecule (O_2) and reformation of the free chlorine atom (CI). The depletion of O_3 is catalystic. The element that destroys O_3 (i.e chlorine) is being reformed at the end of cycle. A single chlorine atom destroys thousands of ozone molecules before encountering reactive nitrogen or hydrogen compounds that eventually return chlorine to its reservoirs.

CFC-12 (R-12) is a widely used refrigerant. HFC 134a (R-134a) is the most promising alternative (R-143a) and (R-152a) can also be used.

Nitrogen Oxides: The sources of nitrogen oxides are mainly explosions of thermonuclear weapons, industrial emissions and agricultural fertilizers.

The escape of N_2O Nitrous oxide (N_2O) is released from solid through denitrification of nitrates under anaerobic conditions and nitrification of ammonia under aerobic conditions. This N_2O can gradually reach the middle of the stratosphere, where it is photolytically destroyed to yield nitric oxide which in turn destroys ozone.

Other substances:
Bromine containing compounds called halons and HBFCs, i.e. hydrobromo fluorocarbons [both used in fire extinguishers and methyl bromide (a widely used pesticide)]. Each bromine atom destroys hundred times of more ozone molecules than what a chlorine atom does.

Sulphuric acid particles: These particles free chlorine from molecular reservoirs, and convert reactive nitrogen into inert forms thus preventing the formation of chlorine reservoirs. Carbon tetrachloride (a cheap, highly toxic solvent) and methyl chloroform (used as a cleaning solvent for clothes and metals, and a propellant in a wide range of consumer products, such as correction fluid, dry cleaning sprays, spray adhesives) and other aerosols.

Monitoring the Ozone Layer

• World Meteorological Organization (WMO) • World Weather Watch (WWW) • Integrated Global Ocean Services Systems (IGOSS) • Global Climate Observing System (GCOS)

Role of polar stratospheric clouds in ozone depletion.

1. Nacreous clouds extend from 10 to 100km in length and several km in thickness. They are also called 'mother-of-pearl' clouds due to their glow with a seashell like iridescence.
2. The second type of clouds contain nitric acid instead of pure water.
3. The third type of clouds have the same chemical composition as nacreous clouds, but form at a slower rate, which results in a larger cloud with no iridescence.

The chlorine released by the breakdown of CFCs exists initially as pure chlorine or as chlorine monoxide (active chlorine / instable) but these two forms react further to form compounds Chlorine nitrate and HCL that are stable (inactive chlorine).The stable compounds HCL and $CLONO_2$ are reservoirs of chlorine, and therefore for chlorine to take part in reactions of any sort, it has to be freed . ***The ice particles of the cloud provided substrates for chemical reactions which freed chlorine from its reservoirs.*** Usually the reaction between HCl and $ClONO_2$ is very slow, but this reaction occurs at a faster rate in the presence of a suitable substrate which is provided by the stratospheric clouds at the poles.

HCl + Chlorine nitrate ⟶ molecular chlorine

It results in the formation of molecular chlorine and nitric acid. The molecular chlorine formed in the above reaction can be broken down to atomic chlorine and the ozone depletion reaction would continue. The PSCs not only activate chlorine, but they also absorb reactive nitrogen. If nitrogen oxides were present they would combine with chlorine monoxide to form a reservoir of chlorine nitrate ($ClONO_2$).
Dimer of chlorine monoxide: Stratospheric chlorine monoxide reacts with itself forming a dimer Cl_2O_2. This dimer is easily dissociated by sunlight, giving rise to free chlorine atoms which can further react to destroy ozone.

Why is the Ozone Depletion predominant at the Antarctic?

• The Antarctic stratosphere is much colder. The low temperature enables the formation of Polar stratospheric Clouds (PSCs), below 20 km.
• Ozone absorbs sunlight, causing the characteristic increase in temperature with increase in altitude in the stratosphere. If ozone is being depleted, the air becomes cooler, further adding to the favourable conditions for the formation of PSCs and stabilization of the vortex. The vortex is a ring of rapidly circulating air that confines the ozone depletion in the Antarctic region.
• The longevity of the Antarctic vortex is another factor, enhancing favourable conditions for the depletion of ozone. The vortex remains, in fact, throughout the polar winter, well into midspring whereas the vortex in the Arctic disintegrates by the time the polar spring (March/April) arrives.
• In June Antarctic winter begins, the vortex develops and the temperature falls enough for the clouds to form.
• During July and August PSCs denitrify and dehydrate the stratosphere through precipitation, hydrochloric acid and chlorine nitrate react on cloud surfaces to free chlorine and winter temperatures drops to their lowest point.
• In September sunlight returns to the centre of the vortex as the austral spring begins and PSCs disappear because of increasing temperature. ClO-ClO and ClOBrO catalystic cycles destroy ozone.

• During October lowest levels of ozone are reached.
• In November, Polar vortex breaks down, ozone-rich are from the mid-latitudes replenishes the Antarctic stratosphere and ozone-poor air spreads over the southern hemisphere.

Arctic Ozone Depletion which swept across Britain in March 96 was the greatest depletion of ozone ever seen in the northern hemisphere. Scientists claim that it had been caused, in past, by a dramatic cooling of the upper atmosphere in the northern latitudes over. The ozone depletion over the northern hemisphere has been increasing steadily since the winter of 1992. Apart from the build-up of ozone depleting chemicals, the main cause is the increasing cold temperature in the arctic stratosphere which encourages the formulation of PSCs.

Environmental Effects Of Ozone Depletion Decrease in the quantity of total-column ozone; tend to cause increased penetration of solar UV-B radiation (290-315nm) to the earth's surface. UV-B radiation is the most energetic component of sunlight reaching the earth's surface.

Effects of human and animal health

- Potential risks include an increase in the incidence of and morbidity from eye diseases, skin cancer and infectious diseases.
- damage the cornea and lens of the eye. Experiments in animals show that UV exposure decreases the immune response to skin cancers, infectious agents and other antigens and can lead to unresponsiveness upon repeated challenges.
- In susceptible (light-skin coloured) populations, UV-B radiations is the key risk factor for development of nonmelanoma skin cancer (NMSC).

Effects on terrestrial plants

- Psychological and developmental processes of plants are affected by UV-B radiation. In forests and grasslands, this is likely to result in changes in the composition of species;
- Indirect changes caused by UV-B such as changes in plant form, biomass allocation to parts of plant, timing of developmental phases and second metabolism may be equally or sometimes more important that the damaging effects of UV-B.

Effects on aquatic ecosystems

- shown to affect both orientation mechanisms and motility in phytoplankton, resulting in reduced survival rates for these organisms.
- found to cause damage in the early developmental stages of fish, shrimp, crab, amphibians and other animals. The most severe effects are decreased reproductive capacity and impaired larval development.

Effects on bio-geochemical cycles

- could affect terrestrial and aquatic bio-geochemical cycles, thus, altering both sources and sinks of greenhouse and chemically important trace gases.

Effects on air quality

- higher photo dissociation rates of key trace gases that control the chemical reactivity of the troposphere.
- can increase both production and destruction of ozone (O_3) and related oxidants such as hydrogen peroxide (H_2O_2), which are known to have adverse effects on human health, terrestrial plants, and outdoor materials.
- Changes in the atmospheric concentrations of the hydroxyl radical (OH) may change the atmospheric lifetimes of climatically important gases such as methane (CH_4) and the CFC substitutes.)
- Increased tropospheric reactivity could also lead to increased production of particulates such as cloud condensation nuclei, from the oxidation and subsequent nucleation of sulphur, of both antropogenic and natural origin.

Effects on materials

- Synthetic polymers, naturally occurring bio-polymers, as well as some other materials of commercial interest are adversely affected by solar UV radiation.
- The application of these materials, particularly, plastics, in situations which demand routine exposure to sunlight is only possible through the use of light-stabilizers and / or surface treatment to protect them from sunlight.
- Any increase in solar UV-B content due to partial ozone depletion will therefore accelerate the photogradation rates of these materials, limiting their life outdoors.

AGRICULTURE AND FOOD SECURITY

- Climate Change can affect crop yield as well as types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth, as well as the prevalence of pests.
- Moderate warming (increase of 1 to 3°C in mean temperature) is expected to benefit crop yields in temperate regions, while in lower latitudes especially seasonally dry tropics, even moderate temperature increases (1 to 2°C) are likely to have negative impacts for major cereal crops. Warming of more than 3°C is expected to have negative effect on production in all regions.
- The **Third Assessment Report of the IPCC, 2001** concluded that climate change would hit the poorest countries severely in terms of reducing the agricultural products. The Report claimed that crop yield would be reduced in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect/ pest incidence.
- As a result of thawing of snow, amount of arable land in high-latitude region is likely to increase by reduction of the amount of frozen lands. At the same time arable land along the coast lines are bound to be reduced as a result of rising sea level.
- Erosion, submergence of shorelines, salinity of the water table due to the increased sea levels, could mainly affect agriculture through inundation of low lying lands.
- The **International Commission for Snow and Ice (ICSE)** reported that Himalayan glaciers – that are the principal dry-season water sources of Asia's biggest rivers - Ganges, Indus, Brahmaputra, Yangtze, Mekong, Salween and Yellow – are shrinking quicker than anywhere else and that if current trends continue they could **disappear altogether by 2035**.

Impacts on Indian agriculture

- A large part of the arable land in India is rain-fed, the productivity of agriculture depends on the rainfall and its pattern.
- Agriculture will be adversely affected not only by an increase or decrease in the overall amounts of rainfall but also by shifts in the timing of the rainfall.
- Semi arid regions of western India are expected to receive higher than normal rainfall as temperatures soar, while central India will experience a decrease of between 10 and 20 per cent in winter rainfall by the 2050s.
- Productivity of most crops may decrease due to increase in temperature and decrease in water availability, especially in Indo-Gangetic plains. Rising temperature would increase fertilizer requirement for the same production targets and result in higher GHG emissions, ammonia volatilization and cost of crop production.

WATER STRESS AND WATER INSECURITY

- By 2020, between 75 and 250 million people are projected to be exposed to increased water stress due to climate change.
- By 2050s freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease. A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing of run-off.
- The frequency of severe floods in large river basins has increased during the 20th century. Rising temperatures will further affect the physical, chemical and biological properties of fresh water lakes and rivers, with predominantly adverse impacts on many individual fresh water species, community composition and water quality.
- In coastal areas, sea level rise will exacerbate water resource constraints due to increased salinisation of groundwater

Impacts on water situation in India

- In recent decades, the Himalayan region seems to have undergone substantial changes as a result of extensive land use (e.g. deforestation, agricultural practices and urbanization), leading to frequent hydrological disasters, enhanced sedimentation and pollution of lakes
- Available records suggest that the **Gangotri glacier is retreating about 28 m per year**.
- As result of increase in temperature significant changes in rainfall pattern have been observed during 20th century in India.
- A serious environmental problem has also been witnessed in the **Indo-Gangetic Plain Region (IGPR)** in the past whereby different rivers (including Kosi, Ganga, Ghaghara, Son, Indus and its tributaries and Yamuna) changed their course a number of times. The recent devastating ***floods in Nepal and Bihar due to change of course of River Kosi*** is a case in point.
- About 83% of the available water is used for agriculture alone. If used judiciously, the demand may come down to about

68% by the year 2050, though agriculture will still remain the largest consumer. Augmentation of the existing water resources by development of additional sources of water or conservation of the existing resources and their efficient use will be needed.

RISE IN SEA LEVELS

- Sea level rise is both due to thermal expansion as well as melting of ice sheets.
- Satellite observations available since the early 1990s show that since 1993, sea level has been rising at a rate per year, significantly higher than the average during the previous half-century. Global temperature increases of 3–4°C could result in 330 million people being permanently or temporarily displaced through flooding.
- Warming seas will also fuel more intense tropical storms.

ECOSYSTEMS AND BIO-DIVERSITY

- Many species may be unable to move to new areas quickly enough to survive changes that rising temperatures will bring to their historic habitats. WWF asserted that ***one-fifth of the world's most vulnerable natural areas may be facing a "catastrophic" loss of species.***
- It have catastrophic impact on the marine ecosystems. They will be affected not only by an increase in sea temperature and changes in ocean circulation, but also by ocean acidification, as the concentration of dissolved carbon dioxide rises. This is expected to negatively affect shell forming organisms, corals and their dependent ecosystems.

IMPACTS ON INDIA'S BIODIVERSITY

- There will be an increase in the phenomenon of **Glacial Lake Outburst Floods (GLOFs)** in eastern and central Himalayas, causing catastrophic flooding downstream, with serious damage to 'life, property, forests, farms, and infrastructure'.
- The Himalayan rivers are closely interlinked with the Indo-Gangetic Ecosystem, which is primarily an agricultural ecosystem, nearly 65-70% of Indians having agriculture as their primary occupation.
- Recent studies have shown that deserts have shown signs of expansion, thus leading to a process called **desertification**.
- The climate patterns have altered the natural attributes of a desert region; for example the floods in the desert district of Barmer in Rajasthan in 2006.
- Most explicit event in the perspective of climate change affecting the marine ecosystem is the example of **coral bleaching**.
- The **Peninsular Ecosystem is basically a monsoon dependent ecosystem**. India is heavily dependent on the monsoon to meet its agricultural and water needs, and also for protecting and propagating its rich biodiversity. Climate change is linked with the changing patterns observed in the monsoons of India.

CLIMATE CHANGE AND HEALTH

- Each year, about 800,000 people die from causes attributable to air pollution, 1.8 million from diarrhea resulting from lack of access to clean water supply, sanitation, and poor hygiene, 3.5 million from malnutrition and approximately 60,000 in natural disasters.
- A warmer and more variable climate would result in higher levels of some air pollutants, increased transmission of diseases through unclean water and through contaminated food.
- Endemic morbidity and mortality due to diarrheal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in hydrological cycle. Flooding also creates opportunities for breeding of disease carrying insects such as mosquitoes.
- The World Health Organization (WHO) in their studies have indicated that due to rising temperatures, malaria cases are now being reported for the first time from countries like Nepal and Bhutan. It has also been predicted that ***an additional 220-400 million people could be exposed to malaria- a disease that claims around 1 million lives annually.***
- Studies suggest that climate change may swell the population at risk of malaria in Africa by 90 million by 2030, and the global population at risk of dengue by 2 billion by 2080s.
- Rising temperatures and changing patterns of rainfall are projected to decrease crop yields in many developing countries, stressing food supplies. This will ultimately translate into wider prevalence of malnutrition/ undernutrition. In some African countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020.
- Depletion of stratospheric ozone results in higher exposure to the UV rays of the sun, leading to an increase in the

incidents of skin cancer. It could also lead to an increase in the number of people suffering from eye diseases such as cataract. It is also thought to cause suppression of the immune system.

- In addition, the negative effects are concentrated on poor populations that already have compromised health prospects, thus ***widening the inequality gap between the most and the least privileged***.

MITIGATION STRATEGIES

CARBON SEQUESTRATION:

- Carbon capture and storage, also known as CCS or carbon sequestration, describes the technologies designed to tackle global warming by capturing CO_2 at power stations, industrial sites or even directly from the air and permanently storing it underground.
- Carbon sequestration may be carried out by **pumping carbon into 'carbon sinks'—** an area that absorbs carbon.
- **Natural sinks** - Oceans, forests, soil etc. **Artificial sinks** - Depleted oil reserves, unmineable mines, etc.
- Carbon capture has actually been in use for years. The oil and gas industries have used carbon capture for decades as a way to enhance oil and gas recovery. Only recently have we started thinking about capturing carbon for environmental reasons.

There are three main steps to carbon capture and storage (CCS) –

- trapping and separating the CO_2 from other gases,
- transporting this captured CO_2 to a storage location,
- storing that CO_2 far away from the atmosphere (underground or deep in the ocean).

Types of Sequestration:

- ***Ocean Sequestration***: Carbon stored in oceans through direct injection or fertilization.
- ***Geologic Sequestration***: Natural pore spaces in geologic formations serve as reservoirs for long-term CO_2 storage. This is thought to have the largest potential for near-term application.
- ***Terrestrial Sequestration***: A large amount of carbon is stored in soils and vegetation, which are our natural carbon sinks. Increasing carbon fixation through photosynthesis, slowing down or reducing decomposition of organic matter, and changing land use practices can enhance carbon uptake in these natural sinks.

Geologic Sequestration Trapping Mechanisms

- ***Hydrodynamic Trapping***: Carbon dioxide can be trapped as a gas under low-permeability cap rock
- ***Solubility Trapping***: Carbon dioxide can be dissolved into a liquid, such as water or oil.
- ***Mineral Carbonation***: Carbon dioxide can react with the minerals, fluids, and organic matter in a geologic formation to form stable compounds/minerals; largely calcium, iron, and magnesium carbonates.

Carbon dioxide can be effectively stored in the earth's subsurface by hydrodynamic trapping and solubility trapping - usually a combination of the two is most effective.

CARBON SINK

Unlike black and brown carbon that contribute to atmospheric GHG, green and blue carbon sequestrate the atmospheric GHG

Green Carbon is carbon removed by photosynthesis and stored in the plants and soil of natural ecosystems and is a vital part of the global carbon cycle. Many plants and most crops, have short lives and release much of their carbon at the end of each season, but forest biomass accumulates carbon over decades and centuries.

- Afforestation and reforestation are measures that can be taken to enhance biological carbon sequestration.

Blue Carbon In particular, coastal ecosystems such as tidal marshes, mangroves, and seagrasses remove carbon from the atmosphere and ocean, storing it in plants and depositing it in the sediment below them by natural processes.

- These coastal ecosystems are very efficient at sequestering and storing carbon - each square mile of these systems can remove carbon from the atmosphere and oceans at rates higher than each square mile of mature tropical forests.

- Furthermore, ***coastal ecosystems have been found to store huge quantities of carbon in organic rich sediments - up to 5 times more carbon than many temperate and tropical forests.***

When lost they not only stop sequestering carbon but also release their stores of carbon and become new sources of climate change causing carbon emissions which can last for centuries.

The Blue Carbon Initiative is the first integrated program with a comprehensive and coordinated global agenda focused on mitigating climate change through the conservation and restoration of coastal marine ecosystems.

- **Conservation International (CI), the International Union for Conservation of Nature (IUCN), and the Intergovernmental Oceanic Commission (IOC) of UNESCO** is collaborating with governments, research institutions, non-governmental and international organizations, and communities around the world to

1) Develop management approaches, financial incentives and policy mechanisms for ensuring conservation and restoration of coastal Blue Carbon ecosystems;
2) Engage local, national, and international governments to ensure policies and regulations support coastal Blue Carbon conservation, management and financing;
3) Develop comprehensive methods for coastal carbon accounting;
4) Develop incentive mechanisms such as carbon payment schemes for Blue Carbon projects;
5) Implement projects around the world that demonstrate the feasibility of coastal Blue Carbon accounting, management, and incentive agreements;
6) Support scientific research into the role and importance of coastal Blue Carbon ecosystems for climate change mitigation.

CARBON CREDIT is a tradeable certificate or permit representing the right to emit 1ton of carbon or carbon dioxide equivalent (tCO2e). An organisation which produces 1ton less of carbon or carbon dioxide equivalent than the standard level of carbon emission allowed for its outfit or activity, earns a carbon credit.

- Countries which are signatories to the **Kyoto Protocol under the UNFCCC** have laid down gas emission norms for their companies to be met by 2012. In such cases, ***a company has two ways to reduce emissions***.

(i) It can reduce the GHG (greenhouse gases) by adopting new technology or improving upon the existing technology to attain the new norms for emission of gases.

(ii) It can tie up with developing nations and help them set up new technology that is eco-friendly, thereby helping developing country or its companies 'earn' credits. This credit becomes a permit for the company to emit GHGs in its own country. But, only a portion of carbon credits of company in developing country can be transferred to the company in developed country.

Developing countries like India and China are likely to emerge as the biggest sellers and Europe is going to be the biggest buyers of carbon credits. Last year global carbon credit trading was estimated at $5 billion, with India's contribution at around $1 billion. China is currently the largest seller of carbon credits controlling about 70% of the market share. ***India's MCX has become first exchange in Asia to trade carbon credits.***

CARBON OFFSETTING

- Carbon offsets are credits for reductions in GHG emissions made at another location, such as wind farms which create renewable energy and reduce the need for fossil-fuel powered energy. Carbon offsets are quantified and sold in metric tonnes of carbon dioxide equivalent (CO_2e).

- Carbon offsetting is often the fastest way to achieve the deepest reductions within businesses and it also often delivers added benefits at the project site, such as employment opportunities, community development programmes and training and education.

- For a carbon offset to be credible it must meet essential quality criteria,

✓ it is additional (***the reduction in emissions would not have occurred without the carbon finance***),
✓ it will be retired from the carbon market so it cannot be double counted
✓ it addresses issues such as permanence (***it delivers the reductions it stated***) and leakage (***the emission reduction in one area doesn't cause an increase in emissions somewhere else***)

CARBON TAX is the potential alternative to the 'cap and trade' method currently used by the protocol. This tax is based on the amount of carbon contained in a fuel such as coal, etc. The aim of this tax is to cause less fossil fuel use and hopefully cause an incentive to use other sources of energy.

- If the carbon tax was implemented it would be gradual and start at a low amount and increase over time to allow better industry and technology to be developed.
- **Five primary reasons why a carbon tax could prove more beneficial than the 'cap and trade' system**.

1) **Predictability** –could help predict energy prices which might also help investments in energy efficiency and alternate fuels.
2) **Implementation** - could be put into use much quicker compared to the legalities that go along with the 'cap and trade' method.
3) **Understandable** –is simpler to understand and may therefore be embraced more by everyday people
4) **Lack of Manipulation** – special interest groups have less of a chance to manipulate a carbon tax because of its simplicity.
5) **Rebates** – like other forms of taxes, the carbon tax could be open for rebates to the public

India's Position on carbon tax:

- India will bring a WTO challenge against any "carbon taxes" that rich countries impose on Indian imports.
- "If they impose such a tax, we will take them to the WTO dispute settlement forum," "We will deal [with this] through hard negotiations. Such barriers are not going to be WTO-compatible and we will fight it." – the minister, MoEF
- Both USA and EU have discussed the possibility of imposing tariffs or other forms of "border carbon adjustment" on goods imported from countries with tax regulations on GHG emissions.

GEO-ENGINEERING primarily aims at modifying and cooling Earth's environment, defeating the environmental damage and ensuing climate changes to make the planet more inhabitable. Geoengineering, at this point, is still only a theoretical Concept.

How Geoengineering Works: 5 Big Plans to Stop Global Warming

1. **Copy a Volcano** A volcanic eruption can bellow many million tons of sulfur-dioxide gas into the atmosphere, creating a cloud that blocks some of the sun's radiation.
   By injecting the atmosphere with sulfur, some scientists believe they could likewise block solar radiation and potentially cool the planet. Those droplets are particularly good at scattering the sun's light back out into space. And because sulfur doesn't heat the stratosphere as much as other aerosols, it wouldn't work against the cooling effect. Hydrogen sulfide is an even better candidate for atmospheric seeding than sulfur dioxide.

2. **Shoot Mirrors Into Space** In order to deflect enough sunlight to bring the Earth's climate back to its pre-industrial level, geoengineers plan to launch a mirror, the size of Greenland and strategically position it between the planet and the sun.

3. **Seed the Sea with Iron** Scientist suggests iron will be the key to turn things around. Phytoplankton, which dwell near the surface, prefer iron. They are also adapt at pulling carbon out of the atmosphere during photosynthesis. When they die after about 60 days, the carbon the organisms have consumed falls to the bottom of the ocean. By pumping iron into sea and stimulating phytoplankton to grow like crazy, scientist believe, global warming could be reversed.

4. **Whiten the Clouds with Wind-Powered Ships** Scientist hopes, like the volcanic eruption, the tops of clouds also reflect solar radiation. Spraying a lot of seawater into the sky by wind powered remotely activated ships to whiten the clouds and thus it will reflect solar radiation.

INDIA'S POSITION ON CLIMATE CHANGE

- India emitted 2597 million tons of CO_2 equivalent GHG in 2019.
- Energy sector was the prime contributor to emissions and with **71% of total emissions** in 2019. Energy sector includes - electricity production, fuel combustion in industries, transport and fugitive emissions.
- Industrial processes and product use contributed 8%; agriculture and waste sectors contributed 18% and 3% respectively to the national GHG inventory. About **12% of emissions were offset by carbon sink action of forests and croplands**.
- India's per capita GHG emission in 2019 was 1.9 tCO2 equivalent, which is less than one- third of the world's per capita emissions and far below than many developed and developing countries.

- India will continue to be a low-carbon economy (World Bank study). India's primary focus is on "adaptation", with specific focus for "mitigation". India has already unveiled a comprehensive **National Action Plan on Climate Change** whose activities are in the public domain.
- India advocates collaborative research in future low carbon technology and access to intellectual property rights (IPRs) as global public goods.

OBSERVED CLIMATE AND WEATHER CHANGES IN INDIA India's National Communication (NATCOM) to UNFCCC has consolidated some of the observed changes in climate parameters in India.

Surface Temperature At the national level, increase of 0.4° C has been observed in surface air temperatures over the past century. A warming trend has been observed along the west coast, in central India, the interior peninsula, and north-eastern India. However, cooling trends have been observed in north-west India and parts of south India.

Rainfall While the observed monsoon rainfall at the all-India level does not show any significant trend, regional monsoon variations have been recorded. A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh, and north-western India (+10% to +12% of the normal over the last 100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (-6% to —8% of the normal over the last 100 years).

Extreme Weather Events Trends are observed in multi-decadal periods of more frequent droughts, followed by less severe droughts. There has been an overall increasing trend in severe storm incidence along the coast at the rate of 0.011 events per year. While the states of West Bengal and Gujarat have reported increasing trends, a decline has been observed in Orissa.

Rise in Sea Level Records of coastal tide gauges in the north Indian Ocean for more than 40 years, reports that sea level rise was between 1.06-1.75 mm per year. These rates are consistent with 1-2 mm per year global sea level rise estimates of IPCC.

Impacts on Himalayan Glaciers

- The available monitoring data on Himalayan glaciers indicates that while recession of some glaciers has occurred in some Himalayan regions in recent years, the trend is not consistent across the entire mountain chain.

CURRENT ACTIONS FOR ADAPTATION AND MITIGATION Current Indian government expenditure on adaptation to climate variability, exceeds 2.6% of the GDP, with agriculture, water resources, health and sanitation, forests, coastal-zone infrastructure and extreme weather events, being specific areas of concern.

AGRICULTURE 2 risk-financing programmes support adaptation to climate impacts. **Crop Insurance Scheme** supports the insurance of farmers against climate risks, and **Credit Support Mechanism** facilitates the extension of credit to farmers, especially for crop failure due to climate variability.

CROP IMPROVEMENT address measures such as development of arid-land crops and pest management, as well as capacity building of extension workers and NGOs to support better vulnerability reducing practices.

DROUGHT PROOFING seek to minimize the adverse effects of drought on production of crops and livestock, and on productivity of land, water and human resources, so as to ultimately lead to drought proofing of the affected areas. They also aim to promote overall economic development and improve the socio-economic conditions of the resource poor and disadvantaged sections inhabiting the programme areas.

FORESTRY **Forest Conservation Act of 1980**, which aimed at stopping the clearing and degradation of forests through a strict, centralized control of the rights to use forest land and mandatory requirements of compensatory afforestation in case of any diversion of forest land for any non-forestry purpose.

- In addition an aggressive afforestation and sustainable forest management programme resulted in annual reforestation of 1.78 mha during 1985-1997, and is currently 1.1 mha annually. Due to this, the carbon stocks in Indian forests have increased over the last 30 years to 7-8 Gigatons of carbon (GtC).

Indian State of Forest Report (ISFR) 2019 reveals that several states have reported an overall increase in green cover but their carbon stock has surprisingly dropped substantially over the past two years.

WATER The National Water Policy stresses that non-conventional methods for utilization of water, including inter-basin transfers, artificial recharge of groundwater, and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, should be practised to increase the utilizable water resources. Many states now have mandatory water harvesting programmes in several cities.

COASTAL REGIONS restrictions have been imposed in the area between 200m and 500m of the HTL (high tide line) while special restrictions have been imposed in the area up to 200m to protect the sensitive coastal ecosystems and prevent their exploitation. This, simultaneously, addresses the concerns of the coastal population and their livelihood. Some specific measures taken in this regard include construction of coastal protection infrastructure and cyclone shelters, as well as plantation of coastal forests and mangroves.

HEALTH The prime objective present of health programmes is the surveillance and control of vector borne diseases such as Malaria, Kala-azar, Japanese Encephalitis, Filaria and Dengue. Programmes also provide for emergency medical relief in the case of natural calamities, and to train and develop human resources for these tasks.

DISASTER MANAGEMENT **National Disaster Management Programme** provides grants-in-aid to victims of weather related disasters, and manages disaster relief operations. It also supports proactive disaster prevention programmes, including dissemination of information and training of disaster-management staff.

INDIA'S NATIONAL ACTION PLAN ON CLIMATE CHANGE hinges on the development and use of new technologies. The implementation of the Plan would be through appropriate institutional mechanisms suited for effective delivery of each individual Mission's objectives and include public private partnerships and civil society action. The focus will be on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation. There are **8 National Missions which form the core of the National Action Plan**, representing multipronged, long term and integrated strategies for achieving key goals in the context of climate change.

NATIONAL SOLAR MISSION a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. Aim is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible.

- Mission will adopt a 3-phase approach, spanning the remaining period of the 11th Plan and first year of the 12th Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013-17) as Phase 2 and the 13th Plan (2017-22) as Phase 3.
- At the end of each plan, and mid-term during the 12th and 13th Plans, there will be an evaluation of progress, review of capacity and targets for subsequent phases, based on emerging cost and technology trends, both domestic and global.
- The aim would be to protect Government from subsidy exposure in case expected cost reduction does not materialize or is more rapid than expected.
- The first phase (up to 2013) will focus on capturing of the low hanging options in solar thermal; on promoting off-grid systems to serve populations without access to commercial energy and modest capacity addition in grid-based systems.
- In the second phase, after taking into account the experience of the initial years, capacity will be aggressively ramped up to create conditions for up scaled and competitive solar energy penetration in the country.

Mission targets are:

- To create an enabling policy framework for the deployment of 100 MW of solar power by 2022.
- The Centre has revised cumulative targets under National Solar Mission from 20,000 MW by 2021-22 to 1,00,000 MW
- The target will principally comprise of 40 GW Rooftop and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects

THE NATIONAL MISSION FOR ENHANCED ENERGY EFFICIENCY (NMEEE) seeks to strengthen the market for energy efficiency by creating conducive regulatory and policy regime. NMEEE has been envisaged to foster innovative and sustainable business models to the energy efficiency sector. It seeks to create and sustain markets for energy efficiency in the entire country which will benefit the country and the consumers".

Objective

Promoting innovative policy and regulatory regimes, financing mechanisms, and business models which not only create, but also sustain markets for energy efficiency in a transparent manner with clear deliverables to be achieved in a time bound manner.

Mission Goals

- Market-based approaches to unlock energy efficiency opportunities, estimated to be about Rs. 74,000 Crores By 2014-15:
- Annual fuel savings in excess of 23 million toe
- Cumulative avoided electricity capacity addition of 19,000 MW
- CO_2 emission mitigation of 98 million tons per year
- **Four New Initiatives to Enhance Energy Efficiency**:

a) Perform Achieve and Trade (PAT)
b) Market Transformation for Energy Efficiency (MEEE)
c) Energy Efficiency Financing Platform (EEP)
d) Framework for Energy Efficient Economic Development (FEEED)

NATIONAL MISSION ON SUSTAINABLE HABITAT seeks to promote sustainability of habitats through improvements in energy efficiency in buildings, urban planning, improved management of solid and liquid waste, modal shift towards public transport and conservation through appropriate changes in legal and regulatory framework.

- It also seeks to **improve ability of habitats to adapt to climate change** by improving resilience of infrastructure, community based disaster management and measures for improving advance warning systems for extreme weather events.
- Extension of the **energy conservation building code** - which addresses the design of new and large commercial buildings to optimize their energy demand;
- Better **urban planning and modal shift to public transport** - make long term transport plans to facilitate the growth of medium and small cities in such a way that ensures efficient and convenient public transport;
- **Recycling of material and urban waste management** - a special area of focus will be development of technology for producing power form waste.
- The National Mission will include a major **R&D programme, focusing on bio-chemical conversion**, **waste water use, sewage utilization and recycling options.**

NATIONAL WATER MISSION (NWM)

- Ensuring integrated water resource management for conservation of water, minimization of wastage and equitable distribution both across and within states.
- Developing a framework for optimum water use through increase in water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing, taking the National Water Policy (NWP) into consideration.
- Ensuring that a considerable share of water needs of urban areas is met through recycling of waste water.
- Meeting water requirements of coastal cities (with inadequate alternative sources of water) through the adoption of new and appropriate technologies such as low-temperature desalination technologies allowing use of ocean water.
- Revisiting NWP to ensure basin-level management strategies to deal with variability in rainfall and river flows due to climate change, including enhancement of storage both above and below ground, implementation of rainwater harvesting and establishment of equitable and efficient management structures.
- Developing new regulatory structures to optimize efficiency of existing irrigation systems, to rehabilitate run-down systems and to expand irrigation to increase storage capacity.
- Promotion of water-neutral and water-positive technologies through the design of a proper incentive structure combined with recharging of underground water sources and adoption of large-scale irrigation programme based on efficient methods of irrigation.

NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM (NMSHE) to develop a sustainable National capacity to continuously assess the health status of the Himalayan Ecosystem and enable policy bodies in their policy-formulation functions and assist States in the Indian Himalayan Region with their implementation of actions selected for sustainable development.

- Building Human and Institutional capacities on climate change related aspects
- Network knowledge institutions and develop a coherent database on all knowledge systems
- Detect and decouple natural and anthropogenic global environmental changes and project future trends on potential

impacts

- Assess the socio-economic and ecological consequences of global environmental change and design appropriate strategies for growth in the economy of the region
- Study traditional knowledge systems for community participation in adaptation, mitigation and coping mechanisms
- Evaluate policy alternatives for regional development plans and Create awareness amongst stakeholders in the region
- Develop regional cooperation to generate a strong knowledge and database for policy interventions

NATIONAL MISSION FOR A GREEN INDIA

- Increased forest/tree cover on 5 million hectares (ha) of forest/non- forest lands and improved quality of forest cover on another 5 million ha of non-forest/forest lands (a total of 10 million ha)
- Improved ecosystem services including biodiversity, hydrological services, and carbon sequestration from the 10 million ha of forest/non-forest lands mentioned above
- Increased forest-based livelihood income of about 3 million households, living in and around the forests
- Enhanced annual CO2 sequestration by 50 to 60 million tons in the year 2020
- Improvement in the quality of forest cover and ecosystem services of forests /non-forests, (including moderately dense, open forests, degraded grassland and wetlands: 5 million ha)
- Eco-restoration/afforestation of scrub, shifting cultivation areas, cold deserts, mangroves, ravines and abandoned mining areas (2 million ha)
- Improvement in forest and tree cover in urban/ peri-urban lands (0.20 million ha)
- Improvement in forest and tree cover on marginal agricultural lands/fallows and other non-forest land under agro-forestry/social forestry (3 million ha)
- Management of public forest/non-forests areas (taken up under the mission) by community institutions
- Adoption of improved fuel wood-use efficiency and alternative energy devices by households in the project area
- Diversification of forest-based livelihoods of about 3 million households living in and around forests
- **Sub-mission 1**: Enhancing quality of forest cover and improving ecosystem services (4.9 million ha)
- **Sub-mission 2**: Ecosystem restoration and increase in forest cover (1.8 million ha)
- **Sub-mission 3**: Enhancing tree cover in urban and semi-urban areas (including institutional lands): 0.20 million ha
- **Sub-mission 4**: Agro-forestry and social forestry (increasing biomass and creating carbon sink): 3 million ha
- **Sub-mission 5**: Restoration of wetlands: 0.10 million ha

NATIONAL MISSION FOR SUSTAINABLE AGRICULTURE (NMSA)

- To devise strategic plans at the agro-climatic zone level so that action plans are contextualized to regional scales in the areas of research and development (R&D), technology and practices, infrastructure and capacity building
- To enhance agricultural productivity through customised interventions such as use of biotechnology to develop improved varieties of crops and livestock, promoting efficient irrigation systems, demonstration of appropriate technology, capacity building and skill development
- To facilitate access to information and institutional support by **expanding Automatic Weather Station networks** to the panchayat level and linking them to existing insurance mechanisms including the Weather Based Crop Insurance Scheme and the **National Agriculture Insurance Scheme (NAIS)**, scaling the returns at that level
- To promote "**laboratory to land" research** by creating model villages and model farm units in rainfed and dryland areas
- To strategise long-term interventions for emission reduction from energy and non-energy uses by way of introduction of suitable crop varieties and farm practices, livestock and manure management
- To realise the enormous potential of growth in dryland agriculture, through the development of drought and pest resistant crop varieties, adopting resource-conserving technologies, providing institutional support to farmers and capacity building of stakeholders.

- **The NMSA has identified 10 key dimensions for adaptation and mitigation: 1. Improved Crop Seeds, Livestock and Fish Culture 2. Water Efficiency 3. Pest Management 4. Improved Farm Practices 5. Nutrient Management 6. Agricultural Insurance 7. Credit Support 8. Markets 9. Access to Information 10. Livelihood Diversification**

The National Mission on Strategic Knowledge for Climate Change (NMSKCC)

- **Formation of knowledge networks** among the existing knowledge institutions engaged in R&D relating to climate science and facilitating data sharing and exchange through a suitable policy framework and institutional support
- **Establishment of global technology watch groups** with institutional capacities to carry out research on risk minimised technology selection for developmental choices
- **Development of national capacity for modeling the regional impact of climate change** on different ecological zones within the country for different seasons and living standards
- **Establishing research networks and encouraging research in the areas of climate change** impacts on important socio-economic sectors like agriculture, health, natural ecosystems, biodiversity, coastal zones, etc.
- **Generation and development of the conceptual and knowledge basis** for defining sustainability of development pathways in the light of responsible climate change related actions
- **Providing an improved understanding and awareness of key climate processes and the resultant climate risks** and associated consequences
- **To complement the efforts undertaken by other national missions**, strengthen indigenous capacity for the development of appropriate technologies for responding to climate change through adaptation and mitigation and promote their utilisation by the government and societies for the sustainable growth of economies
- **Creating institutional capacity for research infrastructure** including access to relevant data sets, computing and communication facilities, and awareness to improve the quality and sector specific scenarios of climate change over the Indian subcontinent
- **Ensuring the flow and generation of human resources** through a variety of measures including incentives to attract young scientists to climate science
- **Building alliances and partnerships through global collaboration in research & technology development** on climate change under international and bilateral science and technology (S&T) cooperation arrangements

National Bio-Energy Mission According to estimates, biomass from agro and agro-industrial residue can potentially generate 25,000 MW of power in India. This can be further raised with wasteland-based integrated energy plantation and power generation systems.

INDC Conference of Parties (COP) of United Nations Framework Convention on Climate Change (UNFCCC) at 19th Session held in Warsaw in November 2013 invited all Parties to initiate domestic preparations for their INDC towards achieving the objective of the Convention and to communicate them, well in advance of the 21st session of the Conference of Parties. The concept of '**Nationally Determined Contributions'**, taking into account the outcomes of both Warsaw COP 19 and Lima COP 20 has to **(i)** reflect the principles of equity and **Common But Differentiated Responsibilities (CBDR)** and **(ii)** the Country's contributions must be seen in a balanced and comprehensive context.

India declared a voluntary goal of reducing the emissions intensity of its GDP by 20–25%, over 2005 levels by 2020, despite having no binding mitigation obligations as per the Convention. A slew of policy measures to promote low carbon strategies and Renewable Energy have resulted in the decline of emission intensity of our GDP by 12% between 2005 and 2010. It is a matter of satisfaction that **United Nations Environment Programme (UNEP) in its Emission Gap Report 2014** ***has recognized India as one of the countries on course to achieving its voluntary goal.***

INDC outlines the post-2020 climate actions they intend to take under a new international agreement. The INDC centre around India's policies and programs on promotion of clean energy, especially renewable energy, enhancement of energy efficiency, development of less carbon intensive and resilient urban centres, promotion of waste to wealth, safe, smart and sustainable green transportation network, abatement of pollution and India's efforts to enhance carbon sink through creation of forest and tree cover. It also captures citizens and private sector contribution to combating climate change.

The INDC proposals are on the following:

a. Sustainable Lifestyles
b. Cleaner Economic Development

c. Reduce Emission intensity of Gross Domestic Product (GDP)
d. Increase the Share of Non Fossil Fuel Based Electricity
e. Enhancing Carbon Sink (Forests)
f. Adaptation
g. Mobilizing Finance
h. Technology Transfer and Capacity Building

In the INDC, the country has focused on adaptation efforts, including:

1) developing sustainable habitats;
2) optimizing water use efficiency;
3) creating ecologically sustainable climate resilient agricultural production systems;
4) safeguarding the Himalayan glaciers and mountain ecosystem;
5) enhancing carbon sinks in sustainably managed forests and implementing adaptation measures for vulnerable species, forest-dependent communities and ecosystems.

India has submitted its **Intended Nationally Determined Contribution (INDC)** to the United Nations Framework Convention on Climate Change. Some of the salient points of the INDC are:

- **To put forward and further propagate a healthy and sustainable way of living** based on traditions and values of conservation and moderation.
- **To adopt a climate-friendly and a cleaner path** than the one followed hitherto by others at corresponding level of economic development.
- **To reduce the emissions intensity of its GDP by 33 to 35 per cent by 2030 from 2005 level**.
- **To achieve about 40 per cent cumulative electric power installed capacity from non-fossil** fuel based energy resources by 2030, with the help of transfer of technology and low cost international finance, including from Green Climate Fund.
- **To create an additional carbon sink of 2.5 to 3 billion tons of CO_2 equivalent through additional forest and tree cover by 2030.**
- To better adapt to change by **enhancing investments in development programs in sectors vulnerable to climate change**, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- **To mobilize domestic and new and additional funds from developed countries** to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.
- **To build capacities, create domestic framework and international architecture** for quick diffusion of cutting edge climate technology in India and for joint collaborative R&D for such future technologies.

INDIAN NETWORK ON CLIMATE CHANGE ASSESSMENT was launched in October 2009 by the Ministry of Environment and Forests (MoEF) in an effort to promote domestic research on climate change, and build on the country's climate change expertise.

- INCCA is a network-based programme of the MoEF, which **consists of over 120 institutions and over 250 scientists** country wide is aimed at bringing in more science-based policy-making, based on measurements, monitoring and modelling.
- The **INCCA has been conceptualized as a Network based Scientific Programme** designed to address and assess the drivers and implications of climate change through scientific research; climate change assessments on various aspects of climate change, associated vulnerabilities and adaptation; devise decision support systems; and build capacity towards management of climate change related risks and opportunities.
- The INCCA will carry out research on the effects of climate change in different regions and sectors in India and suggest suitable adaptation and mitigation steps.
- Objective - to have an independent body of Indian scientists who could "prepare scientific reports at the domestic level about the impact of climate change on various sectors, which can give a real picture and influence the world debate".
- Reports prepared by the INCCA will form a part of **India's National Communication (Nat Com) to the (UNFCCC)**.

INCCA – First Assessment 'India: Greenhouse Gas Emissions 2007 '

- INCCA prepared the country's greenhouse gas (GHG) emission data "India: Greenhouse Gas Emissions 2007" which said the country's emissions grew by 58 per cent during 1994 to 2007

- It covers the sectors of Energy, Industry, Agriculture, Land Use Change and Forest and Waste by sources and removal by sinks presented in this document.

INCCA - Second Assessment 'Climate Change and India: A 4×4 Assessment' addresses the impact of climate change in 2030s to the natural resources and livelihoods of the people in the **4 climate sensitive regions** of Himalayan region, North-East region, the Western Ghats and the Coastal plains for the **4 key sectors** of Agriculture, Water, Health and Natural Ecosystems and Biodiversity.

- The assessment examines the implications of the climate change scenario in 2030s using a regional climate model (PRECIS).
- The assessment also brings out the future areas of work to enhance the knowledge and areas of further improvement in the future assessments.

Impacts

- Warmer seasons: Avg. temp rise: 2.0 deg C predicted. 1.0-4.0 deg C at extreme ranges
- Increased annual precipitation with lower frequency of rainy days; increased intensity
- Cyclonic disturbances of lower frequency; increased intensity and increased risk of storm surges
- Sea-level rise: 1.3mm/year on average

Agriculture

- Up to 50% reduction in maize yields
- 4-35% reduction in rice yields (with some exceptions)
- Rise in coconut yields (with some exceptions); reduced apple production
- Negative impacts on livestock in all regions
- Fresh water supply
- High variability predicted in water yields (from 50% increase to 40-50% reduction)
- 10-30% increased risk of floods; increased risks of droughts

Forests and natural ecosystems

- Increased net primary productivity
- Shifting forest borders; species mix; negative impact on livelihoods and biodiversity

Human health

- Higher morbidity and mortality from heat stress and vector/water-borne diseases
- Expanded transmission window for malaria

NATIONAL COMMUNICATION (NATCOM) has been initiated in 2002 in pursuance of the implementation of the provisions of the Convention, ***funded by the Global Environment Facility*** under its enabling activities programme through the **United Nations Development Programme, New Delhi.**

Parties to the Convention are enjoined to communicate the following information to the Secretariat of the Conference of Parties:

- A national inventory of anthropogenic emissions by sources and removal by sink of all GHGs not controlled by the Montreal protocol, to the extent its capacities, permit, using comparable methodologies to be promoted and agreed upon by the CoP
- A general description of steps taken or envisaged by the Party to implement the Convention.
- Any other information relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including if feasible, material relevant for calculation of global emission trends.
- The National Communication process envisages comprehensive scientific and technical exercises for preparation of inventories of greenhouse gases of anthropogenic origin, reduction of uncertainities in these estimations and vulnerability assessment and adaptation due to climate change, besides other related information of India's initiatives which address the objectives of the Convention.
- Towards preparation of National Communication, a broad participatory approach involving research institutions, technical institutions, universities, government departments, and non-governmental and private organizations has been adopted, necessitated by vast regional diversity and sector complexities in India.

- The Ministry of Environment and Forests (MoEF) is implementing and executing agency of the project.

Work Programme envisaged

- Development of comprehensive inventory for the base year 1994 and improvement of its reliability vis-à-vis earlier estimates. This would entail reducing uncertainties of GHC emission coefficients in key source categories.
- Identification of key steps to be taken towards implementing the Convention.
- Vulnerabilty and adaptation assessment for presentation of information on specific needs and concerns arising from the adverse impacts of climate change.
- Creation of reliable and comprehensive database for all the outputs produced through the **establishment of a 'Data Centre' (DC).** This information will be accessible on the Internet.
- Enhancement of capacity to respond to projected climate change through the preparation of '**Targeted Research Proposal'** for developing a medium to long term action plan.

GHG Inventory Estimations

- In accordance with the provisions of **Article-4 and 12.1 of UNFCCC, preparation of inventories of a basket of gases has been started for the areas of energy, industrial processes, agriculture land use and land use change and forestry (LULUCF) and waste.**
- The gases to be inventoried include carbon dioxide methane, nitrous oxide, hydrofluorocarbons, perfluorocarbon and sulphur hexafluoride released from various anthropogenic sources of the base year 1994.
- This is in addition to estimating historical trends of GHG growth as a part of the initial National Communication to UNFCCC.
- The estimation of national GHG inventories for all sectors is based on the **1996 guidelines of the 'Intergovernmental Panel on Climate Change' (IPCC)** and as good practices guidelines.

INDIA'S POLICY STRUCTURE RELEVANT TO GHG MITIGATION

1. Integrated Energy Policy

- India has in place a detailed policy, regulatory, and legislative structure that relates strongly to GHG mitigation: The Integrated Energy Policy was adopted in 2006.
- Promotion of energy efficiency in all sectors, Emphasis on mass transport, Emphasis on renewables including biofuels plantations and Accelerated development of nuclear and hydropower for clean energy
- Focused R&D on several clean energy related technologies

2. The Rural Electrification Policy, 2006

- It promotes renewable energy technologies where grid connectivity is not possible or cost-effective. **The New and Renewable Energy Policy, 2005,** promotes utilization of sustainable, renewable energy sources, and accelerated deployment of renewables through indigenous design, development and manufacture.
- **The National Environment Policy, 2006**, and the Notification on Environment Impact Assessment (EIA), 2006, reform India's environmental assessment regime. A number of economic activities are required to prepare environment impact assessments, and environment management plans, which are appraised by regulatory authorities prior to start of construction. The EIA provisions strongly promote environmental sustainability

Several other provisions relates to reforming energy markets to ensure that energy markets are competitive, and energy prices reflect true resource costs. These include: **Electricity Act 2005, Tariff Policy 2003, Petroleum & Natural Gas Regulatory Board Act, 2006**, etc.

- The provisions taken together are designed to:

  - ✓ Remove entry barriers and raise competition in exploration, extraction, conversion, transmission and distribution of primary and secondary energy
  - ✓ Accomplish price reform, through full competition at point of sale
  - ✓ Promote tax reform to promote optimal fuel choices
  - ✓ Augment and diversify energy options, sources and energy infrastructure
  - ✓ Provide feed-in tariffs for renewables (solar, wind, biomass cogeneration)

- ✓ Strengthen, and where applicable, introduce independent regulation

LABELLING PROGRAMME FOR APPLIANCES was launched in 2006, and comparative star-based labelling has been introduced for fluorescent tube-lights, air conditioners, refrigerators, and distribution transformers.

- The labels provide information about the energy consumption of an appliance, and thus enable consumers to make informed decisions. The **Bureau of Energy Efficiency has made it mandatory for refrigerators to display energy efficiency** label and is expected to do so for air conditioners as well. The standards and labelling programme for manufacturers of electrical appliances is expected to lead to significant savings in electricity annually.

ENERGY CONSERVATION BUILDING CODE (ECBC) was launched in May, 2007, which addresses the design of new, large commercial buildings to optimize the buildings' energy demand based on their location in different climatic zones. Commercial buildings are one of the fastest growing sectors of the Indian economy, reflecting the increasing share of the services sector in the economy.

- Nearly one hundred buildings are already following the Code, and compliance with the Code has been incorporated into the **mandatory Environmental Impact Assessment requirements for large buildings**.
- It has been estimated that if all the commercial space in India every year conform to ECBC norms, energy consumption in this sector can be reduced by 30-40%. Compliance with ECBC norms is voluntary at present but is expected to soon become mandatory.

Green Building is the essence of which would be to address all the pollution related issues of a building in an integrated and scientific manner. A green building depletes as little of the natural resources during its construction and operation.

- It costs a little more to design and construct a green building**.** However, it costs less to operate a green building that has tremendous environmental benefits and provides a better place for the occupants to live and work in.
- It maximizes the use of efficient building materials and construction practices; optimizes the use of on-site sources and sinks by bio-climatic architectural practices; uses minimum energy to power itself; uses efficient equipment to meet its lighting, air-conditioning, and other needs; maximizes the use of renewable sources of energy; uses efficient waste and water management practices; and provides comfortable and hygienic indoor working conditions.
- It is evolved through a design process that requires all concerned (the architect and landscape designer and the air conditioning, electrical, plumbing, and energy consultants) to work as a team to address all aspects of building and system planning, design, construction, and operation.
- They critically evaluate the impacts of each design decision on the environment and arrive at viable design solutions to minimize the negative impacts and enhance the positive impacts on the environment.
- Building system designed in a way to efficiently use HVAC (heating ventilation and air conditioning), lighting, electrical, and water heating.
- Integration of renewable energy sources to generate energy onsite. Selection of ecologically sustainable materials (with high recycled content, rapidly renewable resources with low emission potential, etc.) for Water and waste management.
- Indoor environmental quality (maintains indoor thermal and visual comfort and air quality)

The 42nd Amendment to the constitution brought about in the year 1974 inserted two new Articles namely. **Art. 48-A** under **Directive principles of State Policy**, making it the responsibility of the State Government to protect and improve the environment and to safeguard the forests and wildlife of the country. **Art. 51-A (g)** under **Fundamental duties of citizens**; making it the fundamental duty of every citizen to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

Green Rating for Integrated Habitat Assessment (GRIHA) has been conceived by TERI and developed jointly with the Ministry of New and Renewable Energy, Government of India.

- The green building rating system devised by TERI and the MNRE is a voluntary scheme.
- The primary objective of the rating system is to help design green buildings and, in turn, help evaluate the 'greenness' of the buildings. The rating system aims to achieve efficient resource utilization, enhanced resource efficiency, and better quality of life in the buildings.

Rating Tool

- GRIHA is a rating tool that helps people assess the performance of their building against certain nationally acceptable benchmarks and is suitable for all kinds of buildings in different climatic zones of the country.
- Going by the old adage '**what gets measured, gets managed'**, GRIHA attempts to quantify aspects such as energy consumption, waste generation, renewable energy adoption, etc. so as to manage, control and reduce the same to the best possible extent.
- It will evaluate the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'.
- The rating system, based on accepted energy and environmental principles, will seek to strike a balance between the established practices and emerging concepts, both national and international.
- ***guidelines/criteria appraisal may be revised every three years to take into account the latest scientific developments*** during this period

The basic features

- The system has been developed to help 'design and evaluate' new buildings (buildings that are still at the inception stages).
- A building is assessed based on its predicted performance over its entire life cycle – inception through operation.
- **GRIHA rating system consists of 34 criteria categorized under 4 categories** which are :

1. Site Selection and Site Planning,
2. Conservation and efficient utilization of resources,
3. Building operation and maintenance, and
4. Innovation points.

- **8 of these 34 criteria are mandatory, 4 are partly mandatory, while the rest are optional**. Each criterion has a number of points assigned to it.
- It means that a project intending to meet the criterion would qualify for the points. Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification is 50.

The benefits

- On a broader scale, this system, along with the activities and processes that lead up to it, will benefit the community at large with the improvement in the environment by reducing GHG emissions, reducing energy consumption and the stress on natural resources.
- Reduced energy consumption without sacrificing the comfort levels
- Reduced destruction of natural areas, habitats, and biodiversity, and reduced soil loss from erosion etc.
- Reduced air and water pollution (with direct health benefits)/ Reduced water consumption
- Limited waste generation due to recycling and reuse, Reduced pollution loads and Increased user productivity
- Enhanced image and marketability

The challenges

- The Indian building industry is highly de-centralized with people and/ or groups engaged in design, construction, equipment provision, installation, and renovation working together.
- Each group may be organized to some extent, but there is limited interaction among the groups, thus disabling the integrated green design and application process. Hence, it is very important to define and quantify sustainable building practices and their benefits.
- It is also important to separate the role of different participants in ensuring that the building consumes minimal resources over its entire life cycle and leaves behind a minimal environmental footprint.

In March 2007 **ENERGY AUDITS OF LARGE INDUSTRIAL CONSUMERS** was made mandatory in large energy-consuming units in 9 industrial sectors. These units, notified as "designated consumers" are also required to employ "certified energy managers", and report energy consumption and energy conservation data annually.

MASS TRANSPORT The **National Urban Transport Policy** emphasizes extensive public transport facilities and non-motorized modes over personal vehicles. The expansion of the Metro Rail Transportation System in Delhi and other cities (Chennai, Kochi, Bangalore, Jaipur, etc) and other mass transit systems, such as the Metro Bus project in Bangalore, are steps in its implementation. ***The State government of Maharashtra recently announced that it will impose a* Congestion tax *to discourage the use of private cars in cities where it has created "sufficient public transport capacity"***.

PROMOTION OF ENERGY SAVING DEVICES

- The Bureau of Energy efficiency has introduced "The Bachat Lamp Yojana", a programme under which households may exchange incandescent lamps for CFLs (compact fluorescent lamps) using clean development mechanism (CDM) credits to equate purchase price.
- Some states have made mandatory the installation of solar water heaters in hospitals, hotels and large government and commercial buildings. Subsidy is provided for installation of solar water heaters in residential buildings.

PROMOTION OF BIOFUELS

- The Biodiesel Purchase Policy mandates biodiesel procurement by the petroleum industry. A mandate on Ethanol Blending of Gasoline requires 5% blending of ethanol with gasoline from 1st January, 2003, in 9 States and 4 Union Territories.

INDIAN SOLAR LOAN PROGRAMME

- In April 2003, the United Nations Environment Programme (***"UNEP") initiated a, 3 year Programme, credit facility in Southern India to help rural households finance the purchase of Solar Home Systems.***
- Canara Bank and Syndicate Bank, along with their 8 associate Regional Rural Banks, partnered with UNEP to establish and run a Loan Programme through their branch offices across Karnataka State and part of the neighbouring Kerala State.
- In addition to providing financial support in the form of interest rate subsidies for borrowers, UNEP provides assistance with technical issues, vendor qualification and other activities to develop the institutional capacity for this type of finance.

NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)

- The ICAR has launched NICRA during 2010-11 with an outlay of Rs.350 crores for the XI Plan.
- To enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies
- **The project is comprised of four components**.

1) Strategic research on adaptation and mitigation
2) Technology demonstration on farmers' fields to cope with current climate variability
3) Sponsored and competitive research grants to fill critical research gaps
4) Capacity building of different stake holders

Strategic Research has been planned at leading research institutes of ICAR in a network mode covering crops, horticulture, livestock, natural resource management and fisheries sectors.

- To begin with, the project is focusing on crops like wheat, rice, maize, pigeonpea, groundnut, tomato, mango and banana; cattle, buffalo and small ruminants among livestock and both marine and freshwater fish species of economic importance.
- **The major research themes are**:

  - Vulnerability assessment of major production zones
  - Linking weather based Agro advisories to contingency planning
  - Assessing the impacts and evolving varieties tolerant to key climatic stresses (drought, heat, frost, flooding, etc.) in major food and horticulture crops
  - Continuous monitoring of GHG in open field conditions in major production systems
  - Evolving adaptation and mitigation strategies through enhancing water and nutrient use efficiency and conservation agriculture
  - Studying changes in pest dynamics, pest/pathogencrop relationships and emergence of new pests and pathogens under changing climate
  - Adaptation strategies in livestock through nutritional and environmental manipulations
  - Harnessing the beneficial effects of temperature in inland and marine fisheries through better understanding of the spawning behaviour.

- 7 major research institutes of ICAR will work in unison to evolve coping technologies with **Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad** as the lead centre.
- Best-bet and cost-effective technologies to cope with climate variability will be demonstrated on farmers' fields in 100 most vulnerable districts of the country.
- The technologies include rain water harvesting and its judicious use, in-situ moisture conservation, drought management strategies, seed and fodder banks, timely and precision agriculture, effective agro-advisory system using Information Communication Technology kiosks.
- Small and marginal farmers in rain-fed, coastal and hill areas will benefit more in view of the focused attention in these regions.
- Capacity building of scientists in frontier areas is another core activity of the project.
- To prepare all stakeholders to face challenges, multipronged awareness generation programs on issues of climate change are planned.

MoEF&CC initiated a national campaign named "Green Good Deeds" weaving around some 500 simple lifestyle habits that can be easily adopted, in an effort to sensitise the hazards of climate and global warming.

BSE-GREENEX Index is a veritable first step in creating a credible market based response mechanism in India, whereby both businesses and investors can rely upon purely quantitative and objective performance based signals, to assess "carbon performance".

- **gTrade Carbon Ex Ratings Services Private Limited** is a company based in India, which has codeveloped the BSE-GREENEX Index in close association with the BSE.
- The BSE-GREENEX Index includes the top 20 companies which are good in terms of Carbon Emissions, Free-Float Market Capitalization and Turnover.
- The Index is a **Cap Weighted Free-Float Market Capitalization weighted Index** comprising from the list of BSE-100 Index. The Index has been back-tested from 1stOctober, 2008 (Base Date) with the base index value of 1000.
- The Index is rebalanced on a bi-annual basis i.e. end of March and September quarters. The September quarter review will be based on the fresh set of carbon emission numbers and the March quarter review will be based on the existing carbon emission numbers but latest financial data.

FAME-INDIA PROGRAMME Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles (FAME India) scheme rolled out in april, 2015 by Union Minister for Heavy Industries and Public Enterprises The scheme will help promote use of electric and hybrid vehicles, and initially, a subsidy of 30% will be provided to the buyers. Phased replacement of fossil fuel-based vehicles with those based on latest technologies will lead to a net saving of Rs 14,000 crore. The scheme is proposed to be implemented over six years, till 2020, which looks at sales of electric and hybrid vehicles up to 60-70 lakh units per year.

LONG TERM ECOLOGICAL OBSERVATORIES (LTEO) for Climate Change Studies are one of the components under the '**Climate Change Action Programme'** with an outlay of Rs. 40 crores in the 12th Plan Period.

- A Science Plan of LTEO was released during the 21st Conference of Parties to the United Nations Framework Convention on Climate Change at Paris in December 2015.
- First phase of the LTEO Programme includes creating a network of field sites to assess the health of eight different biomes of the country namely; Western Himalaya, Eastern Himalaya, North-Western Arid Zone, Central Indian Forests, Western Ghats, Andaman & Nicobar Islands, Jammu & Kashmir and Sundarbans.
- ***LTEO Programme aims to understand the biophysical and anthropogenic drivers of ecosystem change in the selected biomes and their effects on social- ecological responses through a network of scientific institutions.***
- Activities include experimental work to assess the change of structure and function in the natural ecosystems, identification of patterns and drivers of change in the natural ecosystems by monitoring populations of fresh water fish, birds, mammals, herbivores & carnivores, animal movements, soil processes in forests & grasslands, biophysical climatic variables, etc.

THE NATIONAL ADAPTATION FUND FOR CLIMATE CHANGE (NAFCC) is a Central Sector Scheme set up in 2015-16. The aim of NAFCC is to support concrete adaptation activities which mitigate the adverse effects of climate change. The activities under this scheme are implemented in a project mode. The projects related to adaptation in sectors such as agriculture, animal husbandry, water, forestry, tourism etc. are eligible for funding under NAFCC. **National Bank for Agriculture and Rural Development (NABARD) is the National Implementing Entity (NIE).**

In addition, India has **24 other "Critical Initiatives"** in the anvil, for which detailed plans and an institutional framework is being prepared.

UNFCCC

- UN Summit Conference on Environment and Development (UNCED) held in Rio de Janeiro in June 1992 adopted, by consensus, the first multilateral legal instrument on Climate Change, the UN Framework Convention on Climate Change or the UNFCCC.
- In 1992, countries joined UNFCCC, to cooperatively consider what they could do to limit average global temperature increases and the resulting climate change, and to cope with whatever impacts were, by then, inevitable. There are now 195 Parties to the Convention.
- The UNFCCC secretariat supports all institutions involved in the international climate change negotiations, particularly the Conference of the Parties (COP), the subsidiary bodies (which advise the COP), and the COP Bureau (which deals mainly with procedural and organizational issues arising from the COP and also has technical functions).
- All subsequent multilateral negotiations on different aspects of climate change, including both adaptation and mitigation, are being held based on the principles and objectives set out by the UNFCCC.

KYOTO PROTOCOL: COP-3

- By 1995, countries realized that emission reductions provisions in the Convention were inadequate. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol.
- The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997. Due to a complex ratification process, it entered into force on 16 February 2005.
- The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so.

Targets

- sets binding emission reduction targets for 37 industrialized countries and the European community in its 1st commitment period. It only binds developed countries because it recognizes that they are largely responsible for the current high levels of GHG emissions in the atmosphere, which are the result of more than 150 years of industrial activity.
- places a heavier burden on developed nations under it's central principle of "**common but differentiated responsibility**".
- Overall, these targets add up to an average 5% emissions reduction compared to 1990 levels over the five-year period 2008 to 2012.

The architecture of the KP regime: What makes KP tick?

1. **Emissions Reduction Commitments**
   - binding emissions reduction commitments for developed country parties. This meant the space to pollute was limited.
   - GHG, most prevalently carbon dioxide, became a new commodity. KP now began to internalize what was now recognized as an unpriced externality.
2. **Flexible Market Mechanisms**
   - flexible market mechanisms of the KP, based on the trade of emissions permits. KP countries bound to targets have to meet them largely through domestic action— that is, to reduce their emissions onshore.
   - But they can meet part of their targets through 3 "market-based mechanisms" that ideally encourage GHG abatement to start where it is most cost-effective-- for example, in the developing world. Quite simply, it does not matter where emissions are reduced, as long as they are removed from the planet's atmosphere.

The objectives of Kyoto mechanisms:

- Its objective is to facilitate, promote and enforce compliance with the commitments under the Protocol.
- Stimulate sustainable development through technology transfer and investment
- Help countries with Kyoto commitments to meet their targets by reducing emissions or removing carbon from the atmosphere in other countries in a cost-effective way
- Encourage the private sector and developing countries to contribute to emission reduction efforts.

Joint Implementation:

- allows a country with an emission reduction or limitation commitment under the Kyoto Protocol (Annex B Party – developed country) to earn **emission reduction units (ERUs)** from an emission-reduction or emission removal project in another Annex B Party, each equivalent to 1ton of CO_2, which can be counted towards meeting its Kyoto target.
- Joint implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.
- Projects starting as from the year 2000 may be eligible as JI projects, ERU issued from 2008.

Clean Development mechanism:

- allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries.
- It is the first global, environmental investment and credit scheme of its kind, providing standardized emissions offset instrument, CERs. Such projects can earn saleable **Certified emission reduction (CER) credits**, each equivalent to 1ton of CO_2, which can be counted towards meeting Kyoto targets.

Carbon Trading: is the name given to the exchange of emission permits. This exchange may take place within the economy or may take the form of international transaction.

Emission trading/ 'cap-and-trade',

- Emission permit is known alternatively as carbon credit. For each Annex I country, the protocol has assigned a fixed amount of carbon emission in the agreement. This amount is actually the amount of emission which is to be reduced by the concerned country.
- On the other hand, it implies that the country was permitted to emit the remaining amount. This emission allowance is actually one kind of carbon credit.
- The total amount of allowance is then subdivided into certain units. The units are expressed in terms of carbon-equivalent. Each unit gives the owner the right to emit 1Mt of carbon dioxide or other equivalent GHG.

Offset Trading/ Carbon Project/ 'baseline-and credit' trading:

- Another variant of carbon credit is to be earned by a country by investing some amount of money in such projects, known as carbon projects, which will emit lesser amount of green-house gas in the atmosphere.
- According to an estimate made by the **World Bank's Carbon Finance Unit, *volume of carbon trade through Emission Trading route alone had shown a 240 percent increase in 2005 over the previous year*.**

Benefits of Flexible Market Mechanisms

- This has the parallel benefits of stimulating green investment in developing countries and of including the private sector in this endeavour to cut and hold steady GHG emissions at a safe level.
- It also makes "**leap-frogging**" ***more economical that is, the possibility to skip older, dirtier technology for newer, cleaner infrastructure and systems, with obvious longer-term benefits.***
- The Kyoto Protocol compliance mechanism is designed to strengthen the Protocol's environmental integrity, support the carbon market's credibility and ensure transparency of accounting by Parties.

Non-Compliance of Kyoto And Penalties.

- If a country does not meet the requirements for measurements and reporting said country looses the privilege of gaining credit through joint implementation projects.
- If a country goes above its emissions cap, and does not try to make up the difference through any of the mechanisms available, then said country must make up the difference plus an additional thirty percent during the next period.
- The country could also be banned from participating in the 'cap and trade' program.

PARIS CLIMATE CHANGE CONFERENCE COP 21, 2015

- To hold the increase in global average temperature to well below 2 °C above pre industrial levels and
- To pursue efforts to limit temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.

- The Agreement also talks about reaching the global peaking of emissions by the second half of the century, recognizing that peaking will take longer for developing country Parties. The Paris Agreement requires all Parties to put forward their best efforts through "**nationally determined contributions" (NDCs**) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts.

In 2018, Parties will take stock of the collective efforts in relation to progress towards the goal set in the Paris Agreement and to inform the preparation of NDCs. There will also be a global stock take every 5 years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties. The Paris Agreement entered into force on 4 November 2016.

The first session of the Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement (CMA 1) took place in Marrakech, Morocco from 15-18 November 2016. By the close of the Marrakech conference, it had been ratified by 111 countries representing more than 3/4 of global emissions. The agreement defines parties' basic obligations and establishes new procedures and mechanisms. But for these to be fully operational, their details must be further elaborated. This requires the adoption by parties of an extensive set of decisions known loosely as the "**Paris rulebook**."

MARRAKECH CLIMATE CHANGE CONFERENCE –COP22, 2016 Beyond developing the Paris rulebook, parties took actions and made announcements on a range of other issues, including:

1) **Finance** The Paris Agreement requires developed countries to provide biennial reports on financial support provided or mobilized through "public interventions," and on projected levels of future support. In Marrakech, SBSTA began considering how to account for public finance. Issues include whether the accounting should apply only to flows from developed to developing countries or to broader flows of public finance.

2) **Global Stocktake** In Marrakech, parties began discussing how to structure the stocktake, including its format, inputs, timeline, duration, and output, and its linkage to other elements of the Paris architecture.
3) **"Orphan" issues** One of the most contentious items in Marrakech was how to treat a set of so-called orphan issues that are referenced in the Paris Agreement but not assigned to the APA or another body for further consideration. These issues include whether to establish common timeframes for NDCs (parties adopted different timeframes in the first round); any rules around the adjustment by parties of their NDCs; and the **development of a new collective finance goal beyond 2025**. Unable to agree on any specific direction, parties simply asked the APA to continue its consideration of "possible additional matters relating to the implementation of the Paris Agreement."

4) **Adaptation Fund** One holdover issue from Paris was whether the Adaptation Fund established under the Kyoto Protocol, which provides adaptation support to developing countries, would continue under the Paris Agreement. Although developed countries would prefer to channel support through the newly establish Green Climate Fund, developing countries pushed very hard to keep the Adaptation Fund alive. Parties decided the fund "should serve the Paris Agreement," pending decisions on governance and other issues.
5) **2018 Facilitative Dialogue** In Paris, anticipating that the Paris Agreement would not be in force for several years, parties decided to conduct an early stocktake through a "facilitative dialogue" in 2018. (The next round of NDCs is due in 2019/20.) In Marrakech, parties asked the presidencies of COP 22 and COP 23 to jointly undertake consultations on how to organize the facilitative dialogue, and to report back at COP 23.

6) **Mid-century Strategies** The Paris Agreement encourages countries to prepare and submit "long-term low GHG emission development strategies" outlining the kinds of actions needed to achieve much deeper emission reductions. In Marrakech, Canada, Germany, Mexico, and the United States became the first countries to submit what have come to be known as mid-century strategies. A new initiative called the **2050 Pathway Platform** was launched, with support from a broad array of national governments, cities, states, and companies, to help other countries develop their own midcentury strategies.
7) **Finance** Heading into Marrakech, developed countries released a roadmap outlining how they foresee meeting the goal of mobilizing $100 billion a year in public and private finance for developing countries by 2020. In Marrakech, the UNFCCC's Standing Committee on Finance released its second biennial assessment, showing that total global climate finance increased 15 percent in 2013-14, reaching a high bound estimate of $741 billion in 2014.

8) **Countries and others announced a variety of new financial pledges, including:** $23 million for the Climate Technology Centre and Network (CTCN), which provides technical assistance and capacity building for developing countries. More than $50 million for the Capacity-building Initiative for Transparency established in Paris to help

developing countries build the capacity to meet new transparency requirements; and A doubling of World Bank climate finance for the Middle East-North Africa region to $1.5 billion by 2020.

9) Loss and Damage

Parties conducted the first review of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM). The mechanism, established as an interim body at COP 19 and subsequently brought under the Paris Agreement, is charged with developing approaches to help vulnerable countries cope with unavoidable climate impacts, including extreme weather events and slow-onset events such as sea-level rise. The next review will take place in 2019, and further reviews will be conducted on a five-year cycle, which could align with the global stocktakes.

OTHER MECHANISMS OF UNFCCC

1. Special Climate Change Fund (SCCF) was established under the Convention in 2001 to finance projects relating to: adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification.

- The Global Environment Facility (GEF), as an operating entity of the financial mechanism, has been entrusted to operate the SCCF.

2. Finance Mechanism for Climate Change The Financial resources that have been made available to Non-Annex I Parties to the UNFCCC consist of the following three modules:

- **The "National Communications Module":** presents information communicated by Annex II Parties on the provision of financial resources related to the implementation of the Convention through their fourth and fifth national communications.
- **Fast-Start Finance** During the Conference of the Parties (COP15) held in December 2009 in Copenhagen developed countries pledged to provide new and additional resources, including forestry and investments, approaching USD 30 billion for the period 2010 - 2012 and with balanced allocation between mitigation and adaptation. This collective commitment has come to be known as 'fast-start finance'.
- Following up on this pledge, the Conference of the Parties (COP 16)in Cancún, in December 2010, took note of this collective commitment by developed country Parties and reaffirmed that funding for adaptation will be prioritized for the most vulnerable developing countries, such as the least developed countries, small island developing States and Africa.
- At COP 17 Parties welcomed the fast-start finance provided by developed countries as part of their collective commitment to provide new and additional resources approaching USD 30 billion for the period 2010–2012, and noted the information provided by developed country Parties on the fast-start finance they have provided and urged them to continue to enhance the transparency of their reporting on the fulfillment of their fast-start finance commitments.
- **The "Funds Managed by the GEF Module"** is a joint effort between the secretariat of the UNFCCC and the secretariat of the Global Environment Facility (GEF). This module presents information on financial flows that have been channelled, mobilized and leveraged by the GEF in its role as an operating entity of the Financial Mechanism of the UNFCCC.

REDD & REDD+

- REDD (Reducing Emissions from Deforestation and Forest Degradation) is the global endeavour to create an incentive for developing countries to protect, better manage and save their forest resources, thus contributing to the global fight against climate change
- REDD+ goes beyond merely checking deforestation and forest degradation, and includes incentives for positive elements of conservation, sustainable management of forests and enhancement of forest carbon stocks. Countries that reduce emissions and undertake sustainable management of forests will be entitled to receive funds and resources as incentives.

Will India Benefit from REDD+? India's sustained efforts for conserving and expanding it's forest and tree resources have the possibility of being rewarded for providing carbon service to the international community in addition to providing traditional goods and services to the local communities.

- The incentives so received from REDD+ would be passed to the local communities involved in protection and management of the forests. This will ensure sustained protection of our forests against deforestation.
- It is estimated that a REDD+ programme for India could provide capture of more than 1 billion tons of additional CO_2 over the next 3 decades and provide more than USD 3 billion as carbon service incentives under REDD+.

India initiatives related to REDD+

- India has made a submission to UNFCCC on "REDD, Sustainable Management of Forest(SMF) and Afforestation and Reforestation (A&R)" in December 2008
- A **Technical Group** has been set up to develop methodologies and procedures to assess and monitor contribution of REDD+ actions
- A **National REDD+ Coordinating Agency** is being established
- A **National Forest Carbon Accounting Programme** is being institutionalized
- India is hosting the Conference of Parties (COP-11) of the Convention on Biological Diversity (CBD) in 2012, to coincide with twenty years of Rio convention.
- Study on the impact of climate change on India's forests assigned to the **Indian Network for Climate Change Assessment (INCCA)**, has been released in November 2010.
- There is likely to be **an increase in Net Primary Productivity (NPP) ranging from 20 – 57 %.**

THE GEF

- Article 11 of the UNFCCC creates a 'financial mechanism' for convention implementation, which is to function under the guidance of the UNFCCC COP and be accountable to the COP.
- Under Article 11(1), the COP is to decide on the financial mechanism's policies, programme priorities and eligibility criteria relating to the convention.
- Article 21 names the GEF to serve as the financial mechanism on an interim basis.
- The GEF was established in 1991 by the World Bank in consultation with the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP), to provide funding to protect the global environment.
- The GEF's governance, operational, financial and administrative oversight procedures are set out in the **Instrument for the Establishment of the Restructured Global Environment Facility**, which was adopted in 1994 and subsequently amended in 2002 (GEF Instrument).
- **The GEF now has six focal areas**:

1. biological diversity; 2. climate change; 3. international waters; 4. land degradation, primarily desertification and deforestation; 5. ozone layer depletion; and 6. persistent organic pollutants.

CLIMATE-SMART AGRICULTURE

- While agriculture is the sector most vulnerable to climate change, it is also a major cause, directly accounting for about 14% of GHG (IPCC 2007) and yet, agriculture can be a part of the solution: helping people to feed themselves and adapt to changing conditions while mitigating climate change.
- This is called the `**triple win':** interventions that would **increase yields** (poverty reduction and food security), make yields **more resilient** in the face of extremes (adaptation), and make the farm a **solution to the climate change problem** rather than part of the problem (mitigation).

Climate-smart agriculture includes proven practical techniques.

- by **increasing the organic content of the soil** through conservation tillage, its water holding capacity increases, making yields more resilient and reducing erosion.
- **Promoting soil carbon capture** also helps mitigate climate change. Another example is integrated soil fertility management that can lower fertilizer costs, increase soil carbon and improve yields.
- Climate-smart agriculture gives attention to landscape approaches, for example, **integrated planning of land**, agriculture, forests, fisheries and water to ensure synergies are captured. These can be further strengthened by adding **better weather forecasting, more resilient food crops and risk insurance** to cover losses when the vagaries of weather strike.
- If yields increase through such practices and become more stable, it results in improved farm incomes. A more stable income helps enhance the adaptive capacity of farmers. A good number of countries are now showing that it can be done.
- China has been a leader in this, with programs such as **the Loess Plateau** now internationally famous. Brazil has also invested in good quality research and extension and is demonstrating these triple results.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) was established by the UNEP and the World Meteorological Organization (WMO) in 1988 to provide the governments of the world with a clear scientific view of what is happening to the world's climate. The Secretariat coordinates all the IPCC work and liaises with Governments. The secretariat is supported by WMO and UNEP and hosted at WMO headquarters in Geneva.

- It is open to all member countries of the United Nations (UN) and WMO. Currently 195 countries are members of the IPCC.
- The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change
- By endorsing the IPCC reports, governments acknowledge the authority of their scientific content. **The work of the organization is therefore policy-relevant and yet policy-neutral, never policy-prescriptive.**
- The IPCC has delivered on a regular basis the most comprehensive scientific reports about climate change produced worldwide, **the Assessment Reports.**
- It has also responded to the need of the UNFCCC for information on scientific and technical matters through Special Reports, **Technical Papers and Methodology Reports**.
- It has also produced methodologies and guidelines to help Parties to the UNFCCC prepare their national GHG inventories.

NATIONAL GREEN HOUSE GAS INVENTORIES PROGRAMME (NGGIP) was established by IPCC to provide methods for estimating national inventories of greenhouse gas emissions to, and removals from, the atmosphere.

- The guidance produced by the NGGIP is used by countries that are Parties to the UN Framework Convention on Climate Change (UNFCCC) and other to estimate the emissions and removals that they report to the UNFCCC.
- All the IPCC guidance has been compiled by an international range of authors and with an extensive global review process.
- The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (the 2006 Guidelines) are the IPCC's most recent guidance on methods and data for developing estimates of emissions and removals of greenhouse gases.

The Panel decided that the IPCC is responsible for assessing and developing inventory methods and practices which are scientifically sound and relevant to all countries, noting particularly the lack of information in developing countries.

- This includes

  - developing methods for estimating emissions of greenhouse gases (GHGs) by sources and removals by sinks,
  - assessing and developing methods to quantify and to manage uncertainties in the estimates of GHGs,
  - assessing the scientific literature related to the development of GHG emission factors and management of inventories,
  - disseminating information related to inventory methods and practices,
  - identifying the implications of the different options in relation to inventory methods and practices
  - assessing scientific issues related to independent verification.

GREEN ECONOMY The Rio + 20 outcome document identifies green economy in the context of sustainable development and poverty eradication and it affirms that approach will be different in accordance with the national circumstances and priorities for each country.

- Accordingly, green economy in India is seen in the context of sustainable development and inclusive economic growth including poverty eradication. The Government endeavors to address all the three dimensions of sustainable development **(social, economic and environmental) in a balanced manner**. It focuses specifically on the fundamental changes that are required to ensure that economic systems are made more sustainable. Green Economy focuses on the ways to overcome the deeply rooted causes of unsustainable economic development.
- A Green Economy is one whose growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystems.
- The Green Economy is about sustainable energy, green jobs, low carbon economies, green policies, green buildings, agriculture, fisheries, forestry, industry, energy efficiency, sustainable tourism, sustainable transport, waste management, water efficiency and all other resource efficiency.

Transition to green economy Three priorities in transition of economy to green economy are

- decarbonizes the economy; • commit the environmental community to justice and equity; • conserve the biosphere.

A key step forward consists in changing our conception of growth and prosperity – achieving more with less and creating real wealth and quality of life.

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY (TEEB) was launched by Germany and the European Commission in 2007. It is a study led by Pavan Sukhdev. It is an international initiative to draw attention to the global economic benefits of biodiversity. It highlights the growing cost of biodiversity loss and ecosystem degradation and to draw together expertise from the fields of science, economics and policy to enable practical actions.

Aim To assess, communicate and mainstream the urgency of actions through its five deliverables—

1) Science and economic foundations, policy costs and costs of inaction,
2) Policy opportunities for national and international policy-makers,
3) Decision support for local administrators,
4) Business risks, opportunities and metrics
5) Citizen and consumer ownership

The Ministry has launched the Economics of Ecosystems and Biodiversity TEEB-India Initiative (TII) to highlight the economic consequences of the loss of biological diversity and the associated decline in ecosystem services.

ECOLOGICAL FOOTPRINT is a standardized measure of demand for natural capital that may be contrasted with the planet's ecological capacity to regenerate and represents the amount of biologically productive land and sea area necessary to supply the resources a human population consumes, and to assimilate associated waste. Currently, humanity's total ecological footprint is estimated at 1.5 planet Earths—in other words, humanity uses ecological services 1.5 times as fact as Earth can renew them.

The "carbon footprint" is the amount of carbon being emitted by an activity or organization. The carbon component of the ecological footprint converts the amount of carbon dioxide being released into the amount of productive land and sea area of carbon dioxide being released into the amount of productive land and sea area required to sequester it and tells the demand on the Earth that results from burning fossil fuels. The **carbon footprint is 54% of the ecological footprint and its most rapidly growing component having increased 11-fold since 1961.**

Global Footprint Network (GFN) every year presents a report on ecological footprint which maps consumption and requirement of natural resources to sustain it. Lifestyle adopted in developed countries is unsustainable and it will require five Earths to fulfil their lifestyle demands. On the other hand, Indian lifestyle is sustainable where one earth is sufficient. The **Earth Overshoot Report has indicated that the Ecological Footprint of developed countries ranges from 8 to 4 whereas India is at 0.9.**

Scope and Importance of Agriculture

- With a **17.2% contribution to the GDP,** agriculture provides livelihood support to about 2/3 of country's population.
- The sector provides employment to **56.7% of country's work force** and is the single largest private sector occupation.
- Agriculture accounts for about **14.7% of the total export earnings** and provides raw material to a large number of Industries (textiles, silk, sugar, rice, flour mills, milk products).
- The agriculture sector acts as a bulwark in maintaining food security and, in the process, national security as well.
- The allied sectors like horticulture, animal husbandry, dairy and fisheries, have an important role in improving the overall economic conditions and health and nutrition of the rural masses.

Problems of Indian Agriculture • **Fragmentation of land holding.** • **Existence of small and marginal farmers.** • **Regional variation.** • **Dependence of seasonal rainfall.** • **Low productivity of land.** • **Increasing of disguised unemployment.** • **Disorder in marketing of Agricultural products.** • **Weak land reformation.**

Revolutions in Agriculture

Revolution	Related with
Green	Food grain Production
Golden	Fruit Production
Grey	Fertilizer Production
Blue	Fish Production

Black	Petroleum Production
Pink	Prawn Production
Round	Potato Production
Red	Meat/Tomato Production
Silver	Egg/Poultry Production
White	Milk Production
Yellow	Oil seeds Production

Classification Based on growing season

1. **Kharif/Rainy/Monsoon crops**: The crops grown in monsoon months from June to Oct-Nov, Require warm, wet weather at major period of crop growth, also required short day length for flowering. E.g. Cotton, Rice, Jowar, Bajra.
2. **Rabi/winter/cold seasons crops**: The crops grown in winter season from Oct to March month. Crops grow well in cold and dry weather. Require longer day length for flowering. E.g. Wheat, gram, sunflower etc.
3. **Summer/Zaid crops**: The crops grown in summer month from March to June. Require warm dry weather for major growth period and longer day length for flowering. E.g. Groundnuts, Watermelon, Pumpkins, Gourds.

FARMING SYSTEMS

1) **Wetland farming** practice of growing crops in soils flooded through natural flow of water for most part of the year.
2) **Garden land/ irrigated Dry land farming** Growing crops with supplemental irrigation by lifting water from underground sources.
3) **Dry land farming** is the practice of crop production entirely depending upon rainfall and the moisture conserved in the soil. This is practiced in areas where annual rainfall is less than 750mm.The crops may face moisture stress frequently due to erratic distribution or failure of monsoon
4) **Rain fed farming** Crop production in areas where rainfall is more than 750mm (i.e assured rainfall areas). Here moisture stress will be minimum. Soil conservation is given more importance
5) **Mixed Farming** is defined as a system of farming on a particular farm which includes crop production, raising live stock, poultry, fisheries, bee keeping etc. to sustain and satisfy as many needs of the farmer as possible. Subsistence is important objective of mixed farming. While higher profitability without altering ecological balance is important in farming system.
   Advantages:
   1. It offers highest return on farm business, as the byproducts of farm are properly utilized.
   2. It provides work throughout year.
   3. Efficient utilization of land, labour, equipment and other resources.
   4. The crop by-products such as straw, fodder etc. is used for feeding of livestock and in return they provide milk.
   5. Manures available from livestock to maintain soil fertility.
   6. It helps in supplying all the food needs of the family members.
6) **Specialized Farming** The farm in which 50% or more income of total crop production is derived from a single crop is called specialized farming
7) **Diversified Farming** has several production enterprises or sources of income but no source of income equal as much as 50% of the total income. It is also called as general farming.

CROP ROTATION is growing of different crops on a piece of land is a preplanned succession. The principle of crop rotation is to utilise the available resources to the fullest extent in order to harvest the maximum in a unit land without affecting the soil health. • Ex- Rice-Red Gram -Banana

Principles of crop rotation

- Leguminous crops should be grown before non-leguminous crops because legumes fix atmospheric N into the soil and add organic matter to the soil.
- Crops with tap roots (deep rooted like cotton) should be followed by those which have fibrous (shallow rooted crops like sorghum or maize) root system. This facilitates proper and uniform use of nutrients from the soil.
- More exhaustive crops should be followed by less exhaustive crops because crops like potato, sugarcane, maize etc. need more inputs such as better tillage, more fertilizers, greater number of irrigation etc.
- Selection of crop should be based on need or demand

- Crops of same family should not be grown in succession because they act as alternate hosts for insect pests and diseases
- The selection of crops should suit farmers' financial conditions, the soil and climatic condition

ORGANIC FARMING is a production system where all kinds of agricultural products are produced organically, including grains, meat, dairy, eggs, fibers such as cotton, flowers, and processed food products

- Organic farming avoids or largely excludes the use of synthetic fertilizers, pesticides, growth regulators and livestock feed additives.
- It largely rely upon crop rotations, crop residues, animal manure, legumes, green manure, on/off farm organic wastes, mechanical cultivation, mineral bearing rocks and aspects of biological control of pests and diseases to maintain soil productivity and tilth to supply plant nutrients.

Concepts

1. Building up of biological soil fertility
2. Control of pests, diseases and weeds through development of an ecological balance within the system and by use of bioagents and various cultural techniques.
3. It recycles all wastes and manure within the farm.

- The components of organic farming are i) Organic manures ii) Non- chemical weed control and iii) Biological pest and disease management.
- The three interrelated principles are i) Mixed farming ii) Crop rotation iii) Organic cycle optimization

Eco-farming:

- It is the farming mutually reinforcing ecological approaches to food production. It aims at the maintenance of soil chemically, biologically and physically the way nature would do if left alone. Soil would then take proper care of plants growing on it. **Feed the soil, not the plant is the watchword and slogan of ecological farming**.

Organic Fertilizers	Inorganic Fertilizer
Three common forms: animal manure, green manure and compost.	Does not add humus to the soil, resulting in less ability to hold water and support living organisms (earthworms, beneficial bacterial, and fungi, etc.)
Improves soil texture, adds organic nitrogen, and stimulates beneficial bacterial and fungi.	Lowers oxygen content of the soil thereby keeping fertilizer from being taken up efficiently.
Improves water-holding capacity of soil.	Supplies only a limited number of nutrients (usually nitrogen and phosphorus)
Helps to prevent erosion	Requires large amounts of energy to produce, transport, and apply. Release nitrous oxide (N2O) —a greenhouse gas

Role of manures

1. Organic manures bind the sandy soil and improve its water holding capacity.
2. They open the clayey soil and help in aeration better root growth.
3. They add plant nutrients in small percentage and also add micro nutrients which are essential for plant growth the microbial activity is increased which helps in releasing plant nutrients in available for e.g. bulky organic manures- FYM, compost from organic waste, night soil, sludge, sewage, sheep folding, green manures, concentrated organic manures- oilcakes (edible, non-edible), blood meal, fish meal, bone meal.
4. Organic manures should be incorporated before the sowing or planting because of slow release of nutrients

Integrated Nutrient Management (INM)

- Judicious combination of organic, inorganic and biofertilizers which replenishes the soil nutrients which are removed by the

crops is referred as Integrated Nutrient Management system There is a need to develop more efficient, economic and integrated system of nutrient management for realizing high crop productivity without diminishing soil fertility.

Watershed Management A watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a lager river (or) lake.

Micro Irrigation is defined as the methods in which low volume of water is applied at low pressure & high frequency. The system has extensive network of pipes at operated at low pressure. At pre-determined spacing outlets are provided for emission water generally known as emitters.

Sprinkler Irrigation water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles.

Drip irrigation: is also called trickle irrigation and involves dripping water onto the soil at very low rates from a system of small diameter plastic pipes fitted with outlets called emitters. Water is applied close to plants so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involves wetting the whole soil profile.

Terracing: "A terrace is an embankment/ridge of earth constructed across a slope to control runoff and minimize soil erosion". It reduces the length of hill side slope, thereby reducing sheet and rill erosion and prevents formation of gullies.

Soil Components

Loam: About equal mixtures of clay, sand, slit, and humus. Rich in nutrients. Holds water but does not become waterlogged.
Slit: Sedimentary material consisting of very fine particles between the size of sand and clay. Easily transported by water.

Podzolization: is a process of soil formation resulting in the formation of Podzols and Podzolic soils. It is the negative of calcification. The calcification process tends to concentrate calcium in the lower part of the B horizon, whereas podzolization leaches the entire column of calcium carbonates. The other bases along with calcium are also removed and the whole soil becomes distinctly acidic. In fact, the process is essentially one of the processes of **acid leaching.**

Gleization is a process of soil formation resulting in the development of a glei in the lower part of the soil profile above the parent material due to poor drainage condition (lack of oxygen) and where waterlogged conditions prevail. Such soils are called **hydro orphic soils.**

Water logging Saturation of soil with water resulting in a rise in the water table.

- Symptoms: Saline water envelops deep roots killing plants; lowers productivity; eventual destruction of plant life.
- Remediation: Switch to less water-demanding plants in areas susceptible to water logging; utilize conservation tillage farming; plant water logging-resistant trees with deep roots; take and out of production for a while; and/ or install pumping stations with drainage pipes that lead to catchment-evaporation basins.
- Loam soils generally contain more nutrients and humus than sandy soils, have better infiltration and drainage than silty soils and are easier to till than clay soils.
- If the topsoil is brown or black, it is rich in nitrogen and is good for crops. If the topsoil is gray, yellow, or red, it is low in organic matter and poor for crops.
- **Border strip irrigation** is an efficient method of irrigation close growing crops. In this method the field is divided by low flat levels into series of strips, each of which is flooded separately.
- **Allelopathy:** is defined as direct or indirect harmful effect of one plant over the other crop species through the exudation of toxic substances from the roots or the decomposition of crop residues
- **Check basin** is a method of irrigation with beds and channel for retaining water to form a pond
- **Heaving:** Injury to plants caused by lifting upward of the plant along with soil from it's normal position in temperate regions where snowfall is common
- **Cover crops:** crops which are grown to cover the soil in order to reduce the loss of the moisture from the soil due to leaching and erosion.
- **Hard pan** is a hard and impermeable layer formed in the soil profile by accumulation of materials such as salts, clay etc which impedes drainage
- **Growth regulators:** Organic substances which in minute amount may participate in the control of growth processes Ex:

Auxins, Cytokinins

- **Hidden hunger:** Is the condition where plants do not exhibit visual symptoms of deficiency for the short supply of particular nutrients but will result in yield losses
- **Humus:** A brown or black organic substance consisting of partially or wholly decayed vegetable or animal matter that provides nutrients for plants and increases the ability of soil to retain water
- **Mulching:** Practice of covering the soil surface with materials like plant residues, straw, leaves or plastic film to reduce evaporation, restrict weed growth and maintain the soil temperature
- **Puddling** is the ploughing operation carried out in stagnated water conditions to create an impervious layer below the plough pan

System of Rice Intensification (SRI) emerged in the 1980's as a synthesis of locally advantageous rice production practices encountered in Madagascar by Fr Henri de Laulanie

- SRI is a combination of several practices those include changes in nursery management, time of transplanting, water and weed management. It emphasizes altering of certain agronomic practices of the conventional way of rice cultivation. All these new practices are together known as System of Rice Intensification (SRI).
- Principle - 'More with Less'
- SRI is not a fixed package of technical specifications, but a system of production with four main components, viz., soil fertility management, planting method, weed control and water (irrigation) management. Rice yield increased with less water and with reduction in chemical inputs.

Sustainable Sugarcane Initiative (SSI) is an innovative set of agronomic practices that involves using less seeds, raising seeds in a nursery, and following new planting methods, with wider seed spacing, and better water and nutrient management to increase the cane yields significantly.

- SSI methods can increase sugarcane yields by at least 20% with 30% less water and a 25% reduction in chemical inputs.
- The SSI method of sugarcane cultivation was evolved from the principles of 'More with Less' followed in SRI and introduced in India by the WWF-ICRISAT collaborative project in 2009.

ENVIRONMENT (PROTECTION) ACT, 1986 genesis lies in **Article 48A (Directive Principles of State Policy**) and **Article 51A (g) (Fundamental Duties)** of the Indian Constitution.

- The Act empowers the Central Government to take all appropriate measures to prevent and control pollution and to establish effective machinery for the purpose of protecting and improving the quality of the environment and protecting controlling and abating environmental pollution.
- The Central Government or any other person duly authorised is empowered to collect the samples of air, water, soil or other substances as evidence of the offences under the Environment (Protection) Act, 1986.
- The Act prescribes **a special procedure for handling hazardous substances** and the concerned person has to handle the hazardous substances according to the procedure of the Act.
- The Environment (Protection) Act, 1986 has relaxed the rule of "Locus Standi" and because of such relaxation even a **common citizen can approach the Court provided he has given a notice of sixty days of the alleged offence** and his intention to make a complaint to the Central Government or any other competent authority.
- **This Act also empowers and authorises the Central Government to issue directions for the operation or process, prohibition, closure, or regulation of any industry**. The Central Government is also authorised to stop, regulate the supply of electricity or water or any other service directly without obtaining the order of the Court in this regard.
- **The Act consists of and deals with more stringent penal provisions**. The minimum penalty for contravention or violation of any provision of the law is an imprisonment for a term which may extend to five years or fine up to one lakh rupees, or both. The Act also provides for the further penalty if the failure or contravention continues after the date of conviction. It is Rs. 5000/- per day. If the failure of contravention continues beyond the period of one year, then the offender is punished with imprisonment for a term which may extend to seven years.
- **The Environment (Protection) Act, 1986 grants immunity to the officers of the Government** for any act done under the provisions of this Act or under the powers vested in them or functions assigned to them under this Act.
- **The Act debars the Civil Courts from having any jurisdiction** to entertain any suit or proceeding in respect of an action,

direction, order issued by Central Government or other statutory authority under this Act.

- The provisions of this Act and the rules or orders made under this Act shall have effect and supremacy over anything inconsistent contained in any enactment other than this Act

NATIONAL FOREST POLICY 1988 The principal aim is to ensure environmental stability and maintenance of ecological balance including atmospheric equilibrium which are vital for sustenance of all life forms, human, animal and plant.

Objectives

- Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna, which represent the remarkable biological diversity and genetic resources of the country.
- Checking soil erosion and denudation in the catchments areas of rivers, lakes, reservoirs in the "interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs.
- Checking the extension of sand-dunes in the desert areas of Rajasthan and along the coastal tracts.
- Increasing substantially the forest/tree cover in the country through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands.
- Increasing the productivity of forests to meet essential national needs.
- Encouraging efficient utilisation of forest produce and maximising substitution of wood.

BIOLOGICAL DIVERSITY ACT, 2002 was born out of India's attempt to realize the objectives enshrined in the **United Nations Convention on Biological Diversity (CBD) 1992** which recognizes the sovereign rights of states to use their own Biological Resources. An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

Objectives

(i) Conservation of biological diversity; (ii) Sustainable use of its components; and (iii) Fair and equitable sharing of the benefits arising from the utilization of genetic resources.

Act envisages a three-tier structure to regulate access to the biological resources, comprising of National Biodiversity Authority (NBA), State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) at the local level.

SCHEDULED TRIBES AND OTHER TRADITIONAL FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS) ACT, 2006 provides for the restitution of deprived forest rights across India, including both individual rights to cultivated land in forestland and community rights over common property resources. The Act is significant as it provides scope and historic opportunity of integrating conservation and livelihood rights of the people.

FRA is a potential tool

I. To empower and strengthen the local self governance
II. To address the livelihood security of the people
III. To address the issues of Conservation and management of the Natural Resources and conservation governance of India.

- **For the first time Forest Rights Act recognises and secures**

i. Community Rights in addition to their individual rights
ii. Right to protect, regenerate or conserve or manage any community forest resource which the communities have been traditionally protecting and conserving for sustainable use.
iii. Right to intellectual property and traditional knowledge related to biodiversity and cultural diversity
iv. Rights of displaced communities & Rights over developmental activities

Salient Features

- **Nodal Agency for the implementation is MoTA.**
- This Act is applicable for Tribal and Other Traditional Forest Dwelling Communities.
- The Act provides for recognition of forest rights of other traditional forest dwellers provided they have for at least three generations prior to 13.12.2005 primarily resided in and have depended on the forest or forest land for bonafide livelihood needs. A "generation" for this purpose would mean a period comprising of 25 years.
- **The maximum limit of the recognizing rights on forest land is 4 ha**.
- National Parks and Sanctuaries have been included along with Reserve Forest, Protected Forests for the recognition of

Rights.

- **The Act recognizes the right of ownership access to collect, use, and dispose of minor forest produce** which has been traditionally collected within or outside village boundaries.
- **The Act has defined the term "minor forest produce" to include all non-timber forest produce** of plant origin, including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu or kendu leaves, medicinal plants and herbs, roots, tubers and the like.
- The Act provides for the forest right relating to Government providing for diversion of forest land for the purpose of schools, hospitals, anganwadis, drinking water supply and water pipelines, roads, electric and telecommunication lines, etc.
- **The rights conferred under the Act shall be heritable but not alienable or transferable** and shall be registered jointly in the name of both the spouses in the case of married persons and in the name of the single head, in the case of a household headed by a single person and in the absence of a direct heir, the heritable right shall pass on to the next of kin
- **The Act provides that no member of a forest dwelling Scheduled Tribe or other traditional forest dwellers shall be evicted** or removed from forest land under his occupation till the recognition and verification procedure is completed.
- As per the Act, the **Gram Sabha has been designated as the competent authority for initiating the process of determining the nature and extent of individual or community forest rights or both** that may be given to the forest dwelling Scheduled Tribes and other traditional forest dwellers.

GREEN HIGHWAYS (PLANTATION, TRANSPLANTATION, BEAUTIFICATION & MAINTENANCE) POLICY - 2015

- India has a total 46.99 lakh kms of road length and out of which over 96214 kms are **National Highways, accounting 2% of total road length**. The Highways carry about 40% of the traffic load. The Ministry has decided to develop all of existing National Highways and 40,000 kms of additional roads in the next few years as **Green Highways**.
- The vision is to develop eco-friendly National Highways with participation of the community, farmers, NGOs, private sector, institutions, government agencies and the Forest Department.
- The objective is to reduce the impacts of air pollution and dust as trees and shrubs along the Highways act as natural sink for air pollutants and arrest soil erosion at the embankment slopes. Plants along highway median strips and along the edges reduce the glare of oncoming vehicles which sometimes become cause of accidents. The community involvement in tree plantation directly benefits local people by generating employment. The Panchayats, NGOs and other Self Help Groups (SHGs) will be involved in the process of planting and maintenance. The plant species selected will be region specific depending on local conditions such as rainfall, climate type of soil.
- **1% of the total project cost of all highways projects will be kept aside for the highway plantation and its maintenance, about Rs. 1000 crore per year will be available for plantation purpose. This policy will generate employment opportunities for about five lakh people from rural areas.**
- In new policy, provisions about the responsibilities attached have also been clearly defined. Now it will be the responsibility of the planting agency to ensure that the condition of the site is good enough for the successful establishment of grasses.
- The monitoring of the plantation status has been included as an integral part of the policy, **strong monitoring mechanism in place by using ISRO's Bhuvan and GAGAN satellite systems.**
- For Highway projects to be environmentally sustainable, it is necessary that the natural resources lost in the process of Highway construction are restored in one way or the other. This requires that ecological needs are taken into consideration from the stage of project planning and designing to its execution. The Highways developed as green corridors not only sustain biodiversity and regenerate natural habitat but also benefit all stakeholders, from road users to local communities and spur eco-friendly economic growth and development.

CHEMICAL SAFETY

- Government has notified two rules viz. Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 for ensuring chemical safety in the Country. These Rules delineate the criteria for identification of **Major Accident Hazard (MAH) unit**. As per these Rules, an off- site emergency plan for a district having MAH unit is required to be in place so as to mitigate the impact of chemical accidents. As per the information received from various Sate and UT, there are 1,861 MAH units in the Country, located in 303 districts.

COASTAL REGULATION ZONE, 2011 In the 1991 Notification the CRZ area was classified as CRZ-I (ecological sensitive), CRZ-II (built-up area), CRZ-III (Rural area) and CRZ-IV (water area). In the 2011 Notification the above

classification is retained. The only change is the **inclusion of CRZ-IV, which includes the water areas up to the territorial waters and the tidal influenced water bodies.** A separate draft Island Protection Zone Notification has been issued for protection of the islands of Andaman & Nicobar and Lakshadweep under Environment (Protection) Act, 1986.

ISLAND PROTECTION ZONE NOTIFICATION, 2011 The geographical areas of these islands are so small that in most of the cases the 500 m Coastal Regulation Zone regulations overlap. Hence, a separate Notification is being issued which takes into account the management of the entire island(except for four islands of A&N which include North Andaman, Middle Andaman, South Andaman and Great Nicobar). The main objectives of the IPZ Notification, 2011are:

- To ensure livelihood security to the fishing communities, tribals and other local communities living in the coastal areas;
- To conserve and protect coastal stretches and;
- To promote development in a sustainable manner based on scientific principles, taking into account the dangers of natural hazards in the coastal areas and sea level rise due to global warming.

SOLID WASTE MANAGEMENT RULES, 2016 62 million tonnes of waste is generated annually in the country at present, out of which 5.6 million tonnes is plastic waste, 0.17 million tonnes is biomedical waste, hazardous waste generation is 7.90 million tons per annum and 15 lakh ton is e-waste. The per capita waste generation in Indian cities ranges from 200 grams to 600 grams per day. 43 million TPA is collected, 11.9 million is treated and 31 million is dumped in landfill sites, which means that **only about 75-80% of the municipal waste gets collected and only 22-28 % of this waste is processed**

The source segregation of waste has been mandated to channelize the waste to wealth by recovery, reuse and recycle. Integration of waste pickers/ ragpickers and waste dealers/ Kabadiwalas in the formal system should be done by State Governments, and Self Help Group, or any other group to be formed. No person should throw, burn, or bury the solid waste generated by him, on streets, open public spaces outside his premises, or in the drain, or water bodies. Generator will have to pay 'User Fee' to waste collector and for 'Spot Fine' for Littering and Non-segregation.

Time frame

1) setting up solid waste processing facilities by all local bodies having 100000 or more population: **within 2 years**
2) census towns below 100000 population, setting up common or stand-alone sanitary landfills by or for all local bodies having 0.5 million or more population and setting up common or regional sanitary landfills by all local bodies and census towns under 0.5 million population- **within three years**
3) bio-remediation or capping of old and abandoned dump sites- **within five years**.

Duties of Waste generator Every waste generator shall segregate and store the waste generated by them in three separate streams namely biodegradable, non-bio-degradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized rag-pickers or waste collectors. **Event organizer of more than 100 persons shall intimate the local authority, at least 3 working days in advance**. Such person or the organizer of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by local authority.

All Resident Welfare and Market Associations, Gated communities and institution with an area >5,000 sq m and all hotels and restaurant shall, within one year from the date of notification of these rules and in partnership with the local authority by the generators as prescribed in these rules, ensure segregation of waste at source, facilitate collection of segregated waste in separate streams, handover recyclable material to either the authorized waste pickers or the authorized recyclers. The biodegradable waste shall be processed, treated and disposed of through composting or bio-methanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local authority. The **developers of Special Economic Zone, Industrial Estate, Industrial park to earmark at least 5% of the total area of the plot or minimum 5 plots/ sheds for recovery and recycling facility**.

Duties of Ministry of Urban Development **MoUD shall formulate National Policy and Strategy on Solid Waste Management** including policy on Waste to Energy in consultation with stakeholders within 6 months from the date of notification of these Rules; review of the measures taken by the States and local bodies, undertake training and capacity building of local bodies and other stakeholders; providing technical guidelines and project finance to States, UTs and local bodies on solid waste management to facilitate meeting timelines and standards.

Promotion of marketing and utilization of compost The **Department of Fertilisers, Ministry of Chemicals and Fertilizers shall provide market development assistance on city compost** and ensure promotion of comarketing of compost with chemical fertilizers in the ratio of 3 to 4 bags: 6 to 7 bags by the fertilizer companies to the extent compost is made available for marketing to the companies. The **Ministry of Agriculture shall provide flexibility in Fertiliser Control**

Order for manufacturing and sale of compost , propagate utlisation of compost on farm land set up laboratories to test quality of compost produced by local authorities or their authorized agencies and issue suitable guidelines for maintaining the quality of compost and ratio of use of compost visa-a-vis chemical fertilizers while applying compost to farmland.

Promotion of waste to energy plant **Ministry of Power shall fix tariff or charges for the power generated from the Waste to Energy plants based on solid waste and ensure compulsory purchase of power generated from such Waste to Energy plants by DISCOMs** . The **Ministry of New and Renewable Energy Sources shall facilitate infrastructure creation for Waste to Energy plants and provide appropriate subsidy or incentives for such Waste to Energy plants**. All industrial units using fuel and located within 100 km from an solid waste based RDF plant shall make arrangements within six months from the date of notification of these rules to replace at least 5 % of their fuel requirement by RDF so produced. **Non recyclable waste having calorific value of 1500 K/cal/kg or more shall not be disposed of on landfills and shall only be utilized for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel.**

HAZARDOUS WASTE MANAGEMENT RULES, 2016 As per the information furnished by CPCB in the year 2015, the total hazardous waste generation in the country is 7.46 million metric tons per annum from about 44,000 industries. Unscientific disposal of hazardous and other waste through burning or incineration leads to emission of toxic fumes comprising of Dioxins & Furans, Mercury, heavy metals, causing air pollution and associated health-related problems. Disposal in water bodies, or in municipal dumps leads to toxic releases due to leaching in land and water entailing into degradation of soil and water quality. The workers employed in such unscientific practices suffer from neurological disorders, skin diseases, genetic defects, cancer etc.

There is a need for systematic management of hazardous and other waste in an environmentally sound manner by way of **prevention, minimisation, re-use, recycling, recovery, utilisation including co processing and safe disposal of waste**. Scientific disposal of hazardous waste through collection, storage, packaging, transportation and treatment, in an environmentally sound manner minimises the adverse impact on human health and on the environment. The **hazardous waste can be disposed at captive treatment facility installed by the individual waste generators or at Common Hazardous Waste Treatment, Storage and Disposal Facilities (TSDFs).**

For the first time, Rules have been made to distinguish between Hazardous Waste and other wastes. Other wastes include: Waste tyre, paper waste, metal scrap, used electronic items, etc. and are recognized as a resource for recycling and reuse. These resources supplement the industrial processes and reduce the load on the virgin resource of the country.

The salient features

1) The ambit of the Rules has been expanded by including 'Other Waste'.
2) **Waste Management hierarchy in the sequence of priority of prevention, minimization, reuse, recycling, recovery, co-processing; and safe disposal has been incorporated.**
3) All the forms under the rules for permission, import/ export, filing of annual returns, transportation, etc. have been revised significantly, indicating the stringent approach for management of such hazardous and other wastes with simultaneous simplification of procedure.
4) The basic necessity of infrastructure to safeguard the health and environment from waste processing industry has been prescribed as Standard Operating Procedure (SOPs), specific to waste type, which has to be complied by the stakeholders and ensured by SPCB/ PCC while granting such authorisation.
5) Procedure has been simplified to merge all the approvals as a **single window clearance for setting up of hazardous waste disposal facility and import of other wastes.**
6) **Co-processing as preferential mechanism** over disposal for use of waste as supplementary resource, or for recovery of energy has been provided.
7) The approval process for co-processing of hazardous waste to recover energy has been streamlined and put on emission norms basis rather than on trial basis.
8) The process of import/export of waste under the Rules has been streamlined by simplifying the document based procedure and by revising the list of waste regulated for import/export.
9) The import of metal scrap, paper waste and various categories of electrical and electronic equipments for re-use purpose has been exempted from the need of obtaining Ministry's permission.
10) The basic necessity of infrastructure to safeguard the health and environment from waste processing industry has been prescribed as Standard Operating Procedure (SOPs) specific to waste type.
11) Responsibilities of State Government for environmentally sound management of hazardous and other wastes have been introduced as follows:

- To set up/ allot industrial space or sheds for recycling, pre-processing and other utilization of hazardous or other waste
- To register the workers involved in recycling, preprocessing and other utilization activities.
- To form groups of workers to facilitate setting up such facilities;
- To undertake industrial skill development activities and ensure safety and health of workers.

12) List of processes generating hazardous wastes has been reviewed taking into account technological evolution in the industries.
13) List of Waste Constituents with Concentration Limits has been revised as per international standard and drinking water standard. The **following items have been prohibited for import**:
    a. Waste edible fats and oil of animals, or vegetable origin;
    b. Household waste;
    c. Critical Care Medical equipment;
    d. Tyres for direct re-use purpose;
    e. Solid Plastic wastes including Pet bottles;
    f. Waste electrical and electronic assemblies scrap;
    g. Other chemical wastes especially in solvent form.
14) State Government is authorized to prepare integrated plan for effective implementation of these provisions, and have to submit annual report to Ministry of Environment, Forest and Climate Change.
15) State Pollution Control Board is mandated to prepare an annual inventory of the waste generated; waste recycled, recovered, utilised including co-processed; waste re-exported and waste disposed and submit to the Central Pollution Control Board by the 30th day of September every year.

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT RULES, 2016 Applies to everyone who generates construction and demolition waste.

Duties of waste Generators

- Every waste generator shall segregate construction and demolition waste and deposit at collection centre or handover it to the authorised processing facilities
- Shall ensure that there is no littering or deposition so as to prevent obstruction to the traffic or the public or drains.
- Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodeling work,
- Large generators shall have environment management plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal / reuse of C & D Waste.
- Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar.

Duties of Service providers and Contractors

- The service providers shall prepare a comprehensive waste management plan for waste generated within their jurisdiction, within six months from the date of notification of these rules,
- Shall remove all construction and demolition waste in consultation with the concerned local authority on their own or through any agency.

Timeframe for implementation

- Million plus cities (based on 2011 census of India), shall commission the processing and disposal facility within one-and-a-half years from date of final notification of these rules
- 0.5 to 1 million cities, shall commission the processing and disposal facility within two years from date of final notification of these rules
- for other cities (< 0.5 million populations), shall commission the processing and disposal facility within three years from date of final notification of these rules

Local Authority shall be responsible for proper management of construction and demolition waste within its jurisdiction including placing appropriate containers for collection of waste, removal at regular intervals, transportation to appropriate

sites for processing and disposal. Procurement of materials made from construction and demolition waste shall be made mandatory to a certain percentage (say 10-20%) in municipal and Government contracts subject to strict quality control.

BIO-MEDICAL WASTE MANAGEMENT RULES, 2016 Total bio-medical waste generation in the country is 484 TPD from 1,68,869 healthcare facilities (HCF), out of which 447 TPD is treated. The hospitals servicing 1000 patients or more per month are required to obtain authorization and segregate biomedical waste in to 10 categories, pack five color backs for disposal. The quantum of waste generated in India is estimated to be 1-2 kg per bed per day in a hospital and 600 gm per day per bed in a clinic. **85% of the hospital waste is non-hazardous, 15% is infectious/hazardous**. Mixing of hazardous results in to contamination and makes the entire waste hazardous. Hence **there is necessity to segregate and treat**. Scientific disposal of Biomedical Waste through segregation, collection and treatment in an environmentally sound manner minimizes the adverse impact on health workers and on the environment.

The salient features

1) The ambit of the rules has been expanded to include vaccination camps, blood donation camps, surgical camps or any other healthcare activity;
2) Phase-out the use of chlorinated plastic bags, gloves and blood bags within two years;
3) Pre-treatment of the laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilisation on-site in the manner as prescribed by WHO or NACO;
4) Provide training to all its health care workers and immunise all health workers regularly;
5) **Establish a Bar-Code System for bags or containers containing bio-medical waste for disposal**;
6) Report major accidents;
7) Existing incinerators to achieve the standards for retention time in secondary chamber and Dioxin and Furans within two years;
8) Bio-medical waste has been classified in to 4 categories instead 10 to improve the segregation of waste at source;
9) Procedure to get authorisation simplified. Automatic authorisation for bedded hospitals. The validity of authorization synchronised with validity of consent orders for Bedded HCFs. One time Authorisation for Non-bedded HCFs;
10) The new rules prescribe more stringent standards for incinerator to reduce the emission of pollutants in environment;
11) **Inclusion of emissions limits for Dioxin and furans**;
12) State Government to provide land for setting up common bio-medical waste treatment and disposal facility;
13) No occupier shall establish on-site treatment and disposal facility, if a service of `common bio-medical waste treatment facility is available at a distance of 75km.
14) Operator of a common bio-medical waste treatment and disposal facility to ensure the timely collection of bio-medical waste from the HCFs and assist the HCFs in conduct of training

Amendment Rules, 2018

- Phase out chlorinated plastic bags (excluding blood bags) and gloves by March 27, 2019.
- All healthcare facilities shall make available the annual report on its website within a period of two years (from 2018).
- Operators of common bio-medical waste treatment and disposal facilities shall establish barcoding and global positioning system for handling of bio-medical waste in accordance with guidelines issued by the CPCB.
- Every person having administrative control over the institution generating biomedical waste shall pre-treat it through sterilization on-site in the manner as prescribed by WHO and then sent to the Common biomedical waste treatment facility for final disposal.

E-WASTE MANAGEMENT RULES, 2016 17 lakh tonnes of E-waste is generated every year, with an annual increase of 5% of generation of E-waste. ***For the first time, the Rules will bring the producers under Extended Producer Responsibility (EPR), along with targets.*** The producers have been made responsible for collection of E-waste and for its exchange

Salient features

1) Manufacturer, dealer, refurbisher and Producer Responsibility Organization (PRO) have been introduced as additional stake holders in the rules.
2) The applicability of the rules has been extended to components, consumables, spares and parts of EEE in addition to equipment as listed in Schedule I.
3) Compact Fluorescent Lamp (CFL) and other mercury containing lamp brought under the purview of rules.

4) Collection mechanism based approach has been adopted to include collection centre, collection point, take back system etc for collection of e-waste by Producers under Extended Producer Responsibility (EPR).
5) Option has been given for setting up of PRO, e-waste exchange, e- retailer, Deposit Refund Scheme as additional channel for implementation of EPR by Producers to ensure efficient channelization of e-waste.
6) **Provision for Pan India EPR Authroization by CPCB has been introduced replacing the state wise EPR authorization**.
7) Collection and channelisation of e-waste in Extended Producer Responsibility - Authorisation shall be in line with the targets prescribed in Schedule III of the Rules. The phase wise Collection Target for e-waste, which can be either in number or Weight shall be 30% of the quantity of waste generation as indicated in EPR Plan during first two year of implementation of rules followed by 40%during third and fourth years, 50% during fifth and sixth years and 70% during seventh year onwards.
8) **Deposit Refund Scheme has been introduced** as an additional economic instrument wherein the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of life electrical and electronic equipment is returned.
9) The **e-waste exchange as an option has been provided in the rules as an independent market instrument** offering assistance or independent electronic systems offering services for sale and purchase of e-waste generated from end-of-life electrical and electronic equipment between agencies or organizations authorized under these rules.
10) The **manufacturer is also now responsible to collect e-waste** generated during the manufacture of any electrical and electronic equipment and channelise it for recycling or disposal and seek authorization from SPCB.
11) The dealer, if has been given the responsibility of collection on behalf of the producer, need to collect the e-waste by providing the consumer a box and channelize it to Producer.
12) Dealer or retailer or e-retailer shall refund the amount as per take back system or Deposit Refund Scheme of the producer to the depositor of e-waste.
13) Refurbisher need collect e-waste generated during the process of refurbishing and channelise the waste to authorised dismantler or recycler through its collection centre and seek one time authorization from SPCB.
14) The roles of the State Government has been also introduced in the Rules in order to ensure safety, health and skill development of the workers involved in the dismantling and recycling operations.
15) The transportation of e-waste shall be carried out as per the manifest system whereby the transporter shall be required to carry a document (three copies) prepared by the sender, giving the details.
16) ***Liability for damages caused to the environment or third party due to improper management of e-waste including provision for levying financial penalty for violation of provisions of the Rules has also been introduced.***
17) Urban Local Bodies (Municipal Committee/Council/ Corporation) has been assign the duty to collect and channelized the orphan products to authorized dismantler or recycler.

Amendment Rules, 2018

- The e-waste collection targets under extended producer responsibility (EPR) have been revised. The phase-wise collection targets for e-waste in weight shall be 10% of the quantity of waste generation as indicated in the EPR Plan during 2017-18, with a 10% increase every year until 2023. From 2023 onwards, the target has been made 70% of the quantity of waste generation as indicated in the EPR Plan.
- Separate e-waste collection targets have been drafted for new producers.
- Under the **Reduction of Hazardous Substances (RoHS) provisions**, cost for sampling and testing shall be borne by the government for conducting the RoHS test. If the product does not comply with RoHS provisions, then the cost of the test will be borne by the Producers.

PLASTIC WASTE MANAGEMENT RULES, 2016

15,000 tons of plastic waste is generated every day, out of which 9,000 tons is collected and processed, but 6,000 tons of plastic waste is not being collected.

Salient features

1) Increase minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 micron for plastic sheets also to facilitate collection and recycle of plastic waste.
2) To promote use of plastic waste for road construction as per Indian Road Congress guidelines or energy recovery, or waste to oil etc. for gainful utilization of waste
3) Rural areas have been brought in ambit of these Rules since plastic has reached to rural areas also. Responsibility for implementation of the rules is given to Gram Panchayat.

4) **First time, responsibility of waste generators is being introduced**. Individual and bulk generators like offices, commercial establishments, industries are to segregate the plastic waste at source, handover segregated waste, pay user fee as per bye-laws of the local bodies.
5) Plastic products are left littered after the public events (marriage functions, religious gatherings, public meetings etc) held in open spaces. **First time, persons organizing such events have been made responsible for management of waste generated from these events.**
6) Use of plastic sheet for packaging, wrapping the commodity except those plastic sheet's thickness, which will impair the functionality of the product are brought under the ambit of these rules. A large number of commodities are being packed/wrapped into plastic sheets and thereafter such sheets are left for littered. Provisions have been introduced to ensure their collection and channelization to authorised recycling facilities.
7) **Extended Producer Responsibility**: Earlier, EPR was left to the discretion of the local bodies. First time, the producers and brand owners have been made responsible for collecting waste generated from their products. They have to approach local bodies for formulation of plan/system for the plastic waste management within the prescribed time frame.
8) SPCBs will not grant/renew registration of plastic bags, or multi-layered packaging unless the producer proposes the action plan endorsed by the concerned State Development Department.
9) Producers to keep a record of their vendors to whom they have supplied raw materials for manufacturing carry bags, plastic sheets, and multi-layered packaging. This is to curb manufacturing of these products in unorganised sector.
10) Entry points of plastic bags/sheets/multilayered packaging in to commodity supply chain are primarily the retailers and street vendors. They have been assigned the responsibility of not to provide the commodities in plastic bags /plastic sheets/multi-layered packaging which do not conform to these rules. Otherwise, they will have to pay the fine.
11) Plastic carry bag will be available only with shopkeepers/street vendors pre-registered with local bodies on payment of certain registration fee. Amount collected as registration fee by local bodies is to be used for waste management.
12) CPCB has been mandated to formulate the guidelines for thermoset plastic (plastic difficult to recycle). In the earlier Rules, there was no specific provision for such type of plastic.
13) **Manufacturing and use of non-recyclable multi-layered plastic to be phased in two years**.

Amendment Rules, 2018

- **Phasing out of Multilayered Plastic (MLP)** is now applicable to MLP, which are non-recyclable, or nonenergy recoverable, or with no alternative use.
- Central registration system for the registration of the producer/importer/brand owner.
- A national registry has been prescribed for producers with a presence in more than two states, a state-level registration has been prescribed for smaller producers/ brand owners operating within one or two states.
- **Explicit pricing of carry bags has been omitted**.

WETLANDS (CONSERVATION AND MANAGEMENT) RULES 2017 supersede the Wetlands (Conservation and Management) Rules, 2010 for effective conservation and management of wetlands in the country.

Decentralisation of wetland management. Under the new rules, the powers have been given to the State governments so that protection and conservation can be done at the local level. The central government has mainly retained powers regarding monitoring. The ***new rules have replaced the Central Wetlands Regulatory Authority (CWRA) with the National Wetland Committee, which has a merely advisory role.***

The State or UT Wetlands Authority will have to prepare a list of all wetlands and also will develop a comprehensive list of activities to be regulated and permitted within notified wetlands and their zone of influence.

The new rules also prohibit encroachments on wetlands, solid waste dumping, discharge of untreated waste and effluents from industries and human settlements. It prescribes that conservation and management would be based on the principle of wise use, which is to be determined by the Wetlands Authority.

Shortfalls

1) The 2010 wetland rules followed the definition of Ramsar convention. However, the 2017 rules, in the definition of wetland do not include river channels, paddy fields, man-made water bodies/tanks specifically for drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation, and irrigation purposes. By this new definition (exclusion of aforesaid wetlands) **close to 65 % wetland in the country will lose the status of wetlands**.

2) The management and protection awarded to river channels, man-made wetlands will be no more effective as they are not considered wetlands. The **definition of wetlands and its inclusion is done by the respective state/ UT**. This may lead to a lack of uniformity in defining and conserving the wetlands in the country.
3) The **older provision of appealing to the National Green Tribunal does not exist in the 2017 Rules.**
4) There is also no timeline specified for phasing out solid waste and untreated waste from being dumped into wetlands.
5) **The new rules do not take into account the Jagpal Singh vs State of Punjab (2011) judgment of Supreme Court for the restoration of encroached wetlands throughout the country.**

NATIONAL GREEN TRIBUNAL (NGT) for the effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources, including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto (**The National Green Tribunal Act, 2010**).

- With the establishment of the NGT, India has joined the distinguished league of countries that have a dedicated adjudicatory forum to address environmental disputes.
- India is third country in the world to full fledged green tribunal followed by new Zealand and Australia.
- The specialized architecture of the NGT will facilitate fast track resolution of environmental cases and provide a boost to the implementation of many sustainable development measures.
- NGT is mandated to dispose the cases within six months of their respective appeals.

THE OZONE DEPLETING SUBSTANCES RULES

- The Ozone Depleting Substances (Regulation and Control)Rules, 2000 under the Environment (Protection) Act, in July 2000.
- These Rules set the deadlines for phasing out of various ODSs, besides regulating production, trade import and export of ODSs and the product containing ODS.
- The Ozone Depleting Substances (Regulation and Control) Rule, 2000 were amended in 2001, 2003, 2004 and 2005 to facilitate implementation of ODS phase-out at enterprises in various sectors.
- These Rules **prohibit the use of CFCs in manufacturing various products beyond 1st January 2003** except in metered dose inhaler and for other medical purposes.
- Similarly, **use of halons is prohibited after 1st January 2001** except for essential use. **Other ODSs such as carbon tetrachloride and methylchloroform and CFC for metered dose inhalers can be used up to 1st January 2010.**
- Further, **the use of methyl bromide has been allowed up to 1st January 2015. Since HCFCs are used as interim substitute to replace CFC, these are allowed up to 1st January 2040.**

NATIONAL WILDLIFE ACTION PLAN was adopted in 1983, based upon the decision taken in the XV meeting of the Indian Board for Wildlife held in 1982. The plan had outlined the strategies and action points for wildlife conservation which are still relevant.

- The first National Wildlife Action Plan (NWAP) of 1983 has been revised and the Wildlife Action Plan (2002- 2016) has been adopted.

Strategy for Action

1. Strengthening and Enhancing the Protected Area Network
2. Effective Management of Protected Areas
3. Conservation of Wild and Endangered Species and Their Habitats
4. Restoration of Degraded Habitats outside Protected Areas
5. Control of Poaching, Taxidermy and Illegal Trade in Wild Animal and Plant Species
6. Monitoring and Research
7. Human Resource Development and Personnel Planning
8. Ensuring Peoples' Participation in Wildlife Conservation
9. Conservation Awareness and Education
10. Wildlife Tourism
11. Domestic Legislation and International Conventions
12. Enhancing Financial Allocation for Ensuring Sustained Fund Flow to the Wildlife Sector
13. Integration of National Wildlife Action Plan with Other Sectoral Programmes

NATIONAL AFFORESTATION AND ECO-DEVELOPMENT BOARD (NAEB) was constituted by the Ministry of Environment and Forests in August 1992. It has evolved specific schemes for promoting afforestation and management strategies, which help states in developing specific afforestation and management strategies and eco-development packages for augmenting biomass production through a participatory planning process of Joint Forest Management and microplanning

National Afforestation Programme was launched in 2002, which involves plantation in degraded forests of the country. It is a flagship programme of National Afforestation and Eco-development Board (NAEB) and **provides physical and capacity building support to the Forest Development Agencies (FDAs), which are the implementing agencies.**

COMPENSATORY AFFORESTATION FUND MANAGEMENT AND PLANNING AUTHORITY (CAMPA)

- While according prior approval under the Forest (Conservation) Act, 1980 for diversion of forest land for non-forest purpose, Central Government stipulates conditions that amounts shall be realised from the user agencies to undertake compensatory afforestation and such other activities related to conservation and development of forests, to mitigate impact of diversion of forest land.
- In April 2004, the central government, under the orders of SC, constituted the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) for the management of money towards compensatory afforestation, and other money recoverable, in compliance of the conditions stipulated by the central government and in accordance with the Forest (Conservation) Act.
- In compliance of Orders passed by the Hon'ble Supreme Court these amounts are deposited in the State-wise accounts operated by an Ad-hoc Authority consisting of two officials of the Ministry of Environment, Forests and Climate Change one representative of the Comptroller and Auditor General and one representative of the Chairperson of the Central Empowered Committee.
- In the absence of permanent institutional mechanism more than Rs.40,000 crores have accumulated with the said ad-hoc Body. So, Central Government introduced the Compensatory Afforestation Fund Bill, 2015 in the LokSabha on 8th May 2015. The Bill also provides for constitution of an authority at national level and at each of the State and Union territory Administration for administration of the funds .

Salient features

- These Funds will receive payments for: (i) compensatory afforestation, (ii) net present value of forest (NPV), and (iii) other project specific payments. The National Fund will receive 10% of these funds, and the State Funds will receive the remaining 90%.
- These Funds will be primarily spent on afforestation to compensate for loss of forest cover, regeneration of forest ecosystem, wildlife protection and infrastructure development.
- The Bill also establishes the **National and State Compensatory Afforestation Fund Management** and Planning Authorities to manage the National and State Funds.

JOINT FOREST MANAGEMENT (JFM) is an initiative to institutionalize participatory governance of country's forest resources by involving the local communities living close to the forest.

- This is a **co-management institution to develop partnerships between forest fringe communities and the Forest Department (FD)** on the basis of mutual trust and jointly defined roles and responsibilities with regard to forest protection and regeneration.
- JFM started in consonance with the National Forest Policy 1988, which has recognized the importance of involving the local communities and the government has issued necessary resolutions and guidelines subsequently to initiate such institutions and strengthen it further.
- **Under JFM, both forest departments and local communities come to an agreement to form the committee to manage and protect forests by sharing the costs and benefits.**
- One of the key objectives of the JFM programme is the **rehabilitation of degraded forestlands with people's participation involving Forest Protection Committees.**
- JFM brings a win-win situation for both forest departments as well as the local communities in terms of greater access to minor forest produces from these regenerated forests.

SOCIAL FORESTRY

- The National Commission on Agriculture, Government of India, first used the term 'social forestry' in 1976.
- It was then that India embarked upon a social forestry project with the aim of taking the pressure off the forests and making use of all unused and fallow land. Government forest areas that are close to human settlement and have been degraded over the years due to human activities needed to be afforested.
- Trees were to be planted in and around agricultural fields. Plantation of trees along railway lines and roadsides, and river and canal banks were carried out. They were planted in village common land, Government wasteland and Panchayat land.
- Social forestry also aims at raising plantations by the common man so as to meet the growing demand for food, fuel wood, fodder, fiber and fertilizer etc, thereby reducing the pressure on the traditional forest area.
- With the introduction of this scheme the government formally recognized the local communities' rights to forest resources, and encouraged rural participation in the management of natural resources. Through the social forestry scheme, the government has involved community participation, as part of a drive towards afforestation, and rehabilitating the degraded forest and common lands.

Social forestry scheme can be categorized into groups

1) **Farm forestry** Individual farmers are being encouraged to plant trees on their own farmland to meet the domestic needs of the family. Non-commercial farm forestry is the main thrust of most of the social forestry projects in the country today. It is to provide shade for the agricultural crops; as wind shelters; soil conservation or to use wasteland.

2) **Community forestry** is the raising of trees on community land and not on private land as in farm forestry. The government has the responsibility of providing seedlings, fertilizer but the community has to take responsibility of protecting the trees.
3) **Extension forestry** Planting of trees on the sides of roads, canals and railways, along with planting on wastelands is known as 'extension' forestry, increasing the boundaries of forests. Under this project there has been creation of wood lots in the village common lands, government wastelands and panchayat lands.

4) **Recreational forestry** Raising of trees with the major objective of recreation alone.

NATIONAL BAMBOO MISSION is a Centrally Sponsored Scheme with 100% contribution from Central Government. It is being implemented by the **Horticulture Division under Department of Agriculture and Co-operation** in the Ministry of Agriculture, New Delhi.

- Bamboo Mission envisages integration of different Ministries/Departments and involvement of local people/ initiatives for the holistic development of bamboo sector in terms of growth of bamboo through increase in area coverage, enhanced yields and scientific management, marketing of bamboo and bamboo based handicrafts, generation of employment opportunities etc.

Objectives of the Mission

- To promote the growth of bamboo sector through an **area based regionally differentiated strategy**;
- To increase the coverage of area under bamboo in potential areas, with suitable species to **enhance yields**;
- To **promote marketing** of bamboo and bamboo based handicrafts;
- To **establish convergence and synergy among stakeholders** for the development of bamboo;
- To promote, develop and disseminate technologies through a seamless blend of traditional wisdom and modern scientific knowledge;
- To generate employment opportunities for skilled and unskilled persons, especially unemployed youths.

Strategy of the Mission

- Adopt a **coordinated approach covering production and marketing** to assure appropriate returns to growers/ producers.
- **Promote Research and Development (R&D)** of genetically superior clones of suitable species and technologies for enhanced production.
- **Enhance acreage** (in forest and non-forest areas) and productivity of bamboo through species change and **improved cultural practices.**

- Promote partnership, convergence and synergy among R&D and marketing agencies in public as well as private sectors, at all levels.
- Promote where appropriate, cooperatives and self help groups to ensure support and adequate return to farmers.
- Facilitate capacity-building and Human Resource Development.
- Set up **National, State and sub-State level structures, to ensure adequate returns for the produce of the farmers and eliminate middlemen**, to the extent possible.

COMPREHENSIVE ENVIRONMENTAL POLLUTION INDEX (CEPI) is a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway, receptor and various parameters like pollutant concentration, impact on human health and level of exposure have been taken into consideration for the calculation of pollution indices for air, water and land.

- The present CEPI is intended to act as an early warning tool. It can help in categorizing the industrial clusters in terms of priority of planning needs for interventions.

Classification of industrial clusters:

CEPI score	status	measures
> 70	critically polluted	detailed investigations and appropriate remedial action
60 – 70	severely polluted	surveillance and implementation of pollution control
< 60	normal	

- The Central and state Pollution Control Board, in collaboration with IIT, Delhi has applied the CEPI for environmental assessment of 88 Industrial Clusters across the country. 43 such industrial clusters having CEPI greater than 70, on a scale of 0 to 100, have been identified as critically polluted.
- The effective implementation of the remedial action plan will help in pollution abatement and to restore the environmental quality of respective industrial clusters and its sustainable use.
- The polluted industrial clusters/areas shall be further explored in order to define the spatial boundaries as well as the extent of eco-geological damages.
- There are still some aspects that need to be improved include, consistency in pollution monitoring data, selection of sampling locations for the environmental monitoring, and collection of data on adverse impact on human population and other geo-ecological features due to industrial pollution.

LIGHTING A BILLION LIVES (LABL) is a campaign by TERI that promotes the use of solar lanterns specially designed and manufactured on a decentralized basis.

- LaBL has been able to engage with government interventions under Sarva Shiksha Abhiyan, Madhya Pradesh Rural Livelihood Project, Rasthriya Gramin Vikas Nidhi, and has facilitated the spread of mobile telephony with support from Department of Telecommunications, Government of India.
- **LaBL has successfully engaged the private sector and leveraged Corporate Social Responsibility (CSR).**
- This initiative has the potential to **contribute towards the realization of the Millennium Development Goals (MDGs)** by improving energy access for the rural poor.
- Formation of more than 100 women-led Self Help Groups (SHGs), and strengthening of around 150 SHGs are among the impacts of this initiative. **The campaign has demonstrated how Public-Private People partnerships can support rural development schemes, particularly in the areas of health, education, environment and women's empowerment.**

ECO MARK is a government scheme of labeling of environment friendly products to provide accreditation and labelling for household and other consumer products which meet certain environmental criteria along with quality requirements of the **Bureau of Indian Standards (BIS)** for that product.

- Objective - to recognize good environmental performance as well as improvements in performance of the unit
- Any product, which is made, used or disposed of in a way that significantly reduces the harm to environment, could be considered as 'Environment Friendly Product'.

- The project would help in capacity building by conducting training, workshops, seminars, conference etc. on the issues pertaining to the industry and environment interface. This would **facilitate the change in attitude of the stakeholders and the industry on the need to support the proactive industry.**

URBAN SERVICES ENVIRONMENTAL RATING SYSTEM (USERS) is a project funded by UNDP executed by Ministry of Environment and Forests and implemented by TERI.

- Aim - to develop **an analytical tool to measure the performance, with respect to delivery of basic services in local bodies of Delhi and Kanpur**. (identified as pilot cities).
- Performance measurement (PM) tool was developed through a set of performance measurement indicators that are benchmarked against set targets using the inputs-outputs efficiency outcomes framework.

BIODIVERSITY CONSERVATION & RURAL LIVELIHOOD IMPROVEMENT PROJECT (BCRLIP)

- Aim - conserving Biodiversity in selected landscapes, including wildlife protected areas/critical conservation areas while improving rural livelihoods through participatory approaches.
- Development of Joint Forest Management (JFM) and eco-development in some states are models of new approaches to provide benefits to both conservation and local communities.
- The project intends to expand to other globally significant sites in the country to strengthen linkages between conservation and improving livelihoods of local communities that live in the neighborhood of biodiversity rich areas-as well as to enhance the local and national economy.
- The Project would be implemented as a Centrally Sponsored Scheme with five financiers (IDA loan, GEF grant, contributions from Government of India, State Governments and beneficiaries), amounting to around Rs. 137.35 crores, spread over 6 years.

NATIONAL CLEAN ENERGY FUND **was constituted in the public account of India in the Finance Bill 2010-11**.

- Objective - to invest in entrepreneurial ventures and research & innovative projects in the field of clean energy technology.
- The Central Board of Excise and Customs consequently notified the Clean Energy Cess Rules 2010 under which producers of specified goods namely raw coal, raw lignite and raw peat were made liable to pay Clean Energy Cess.
- Any project with innovative methods to adopt to clean energy technology and research & development shall be eligible for funding under the NCEF.
- Government assistance under the NCEF shall in no case exceed 40% of the total project cost.

NATIONAL MISSION FOR ELECTRIC MOBILITY to promote electric mobility and manufacturing of electric vehicles in India.

- **The setting up of NCEM has been influenced by the following three factors**:
  1) Fast dwindling petroleum resources
  2) Impact of vehicles on the environment and climate change
  3) Worldwide shift of the automobile industry towards more efficient drive technologies and alternative fuels including electric vehicles
- Barriers are Higher cost of Electric Vehicles, Challenges in battery technology, Consumer mindset, Inadequate government support
- Objective to resolve these barriers by providing government intervention/support, adoption of mission mode approach for fast decision making and ensuring collaboration amongst various stakeholders.
- The NCEM will be the apex body in the Government of India for making recommendations in these matters.

SCIENCE EXPRESS – BIODIVERSITY SPECIAL (SEBS) is an innovative mobile exhibition mounted on a specially designed 16 coach AC train, traveling across India from 5 June to 22 December 2012 (180 days) to create widespread awareness on the unique biodiversity of the country.

- SEBS is the fifth phase of the iconic and path-breaking Science Express.
- The SEBS is a unique collaborative initiative of Department of Science & Technology (DST) and Ministry of Environment & Forests (MoEF), Government of India.
- The state-of-the-art exhibition aboard SEBS aims to create wide-spread awareness on the unique biodiversity of India, Climate Change, Water, Energy Conservation and related issues among various sections of the society, especially students.

ENVIRONMENT EDUCATION, AWARENESS & TRAINING (EEAT) SCHEME is a Central Scheme launched during the **6th Five Year Plan in 1983-84 with the following objectives**:

1. To promote environmental awareness among all sections of the society.
2. To spread environment education, especially in the nonformal system.
3. To facilitate development of education/training materials and aids in the formal education sector.
4. To promote environment education through existing educational/scientific institutions.
5. To ensure training and manpower development for EEAT.
6. To encourage NGOs, mass media and concerned organizations for promoting awareness about environmental issues.
7. To use different media (audio & visual) for spreading messages concerning environment and awareness
8. To mobilize people's participation for preservation and conservation of environment.

NATIONAL ENVIRONMENT AWARENESS CAMPAIGN (NEAC) was launched in 1986 with the objective of creating environmental awareness at the national level. It is a multi-media campaign which utilises conventional and non-conventional methods of communication for disseminating environmental messages.

- Under this campaign, nominal financial assistance is provided to registered NGOs, schools, colleges, universities, research institutions, women and youth organisations, army units, State Government Departments etc. from all over the country for organising/ conducting awareness raising activities.
- These activities which include seminars, workshops, training programmes, camps, rallies, exhibitions, competitions, folk dances and songs, street theatre, puppet shows, preparation and distribution of environmental education resource materials etc., are followed by action like plantation of trees, management of household waste, cleaning of water bodies etc.

ECO-CLUBS (NATIONAL GREEN CORPS)

- The main objectives of this programme are to educate children about their immediate environment and impart knowledge about the eco-systems, their inter-dependence and their need for survival, through visits and demonstrations and to mobilise youngsters by instilling in them the spirit of scientific inquiry into environmental problems and involving them in the efforts of environmental preservation.
- **Global Learning and Observations to Benefit the Environment (GLOBE)** is an International Science and Education Programme, which stress on hands-on participatory approach. India joined this programme during the August, 2000.
- This programme, which unites students, teachers and scientists all over the world, is aimed at school children. The students of GLOBE schools are required to collect data about various basic environmental parameters under the supervision of a GLOBE trained teacher and use it for explaining hypothesis as well as to enhance their scientific understanding of the earth.

MANGROVES FOR THE FUTURE are a partnership-based initiative promoting investment in coastal ecosystems for sustainable development.

Mission

- to promote healthy coastal ecosystems through a partnership-based, people-focused, policy-relevant and investment-orientated approach, which builds and applies knowledge, empowers communities and other stakeholders, enhances governance, secures livelihoods, and increases resilience to natural hazards and climate change.
- Member countries: India, Indonesia, Maldives, Pakistan, Seychelles, Sri Lanka, Thailand, Viet Nam. Outreach countries: Bangladesh, Cambodia, Myanmar, Timor Leste. Dialogue countries: Kenya, Malaysia, Tanzania.
- MFF provides a collaborative platform to help countries, sectors and agencies in the MFF region tackle the growing challenges to coastal sustainability.
- MFF has adopted mangroves as its flagship ecosystem in recognition of the important role that mangrove forests played in reducing the impact of the 2004 Indian Ocean tsunami, and the severe effect on coastal livelihoods caused by the loss and degradation of mangroves.
- However MFF embraces all coastal ecosystems, including coral reefs, estuaries, lagoons, wetlands, beaches and seagrass beds.

THE ANIMAL WELFARE BOARD OF INDIA is a statutory advisory body on Animal Welfare Laws and promotes animal welfare in the country. The first of its kind to be established by any Government in the world, was set up in 1962, in accordance with Section 4 of the Prevention of Cruelty to Animals Acts 1960.

CENTRAL ZOO AUTHORITY The amendment made to the Wild Life (Protection) Act in 1991 added a new chapter dealing with zoos to the Act and allowed for the Central Government to constitute an authority known as the Central Zoo

Authority to oversee the functioning and development of zoos in the country. According to the provisions of this chapter, only such zoos which were operated in accordance with the norms and standards prescribed by the Central Zoo Authority would be granted 'recognition' to operate by the Authority.

THE NATIONAL BIODIVERSITY AUTHORITY (NBA) – CHENNAI was established in 2003 to implement India's **Biological Diversity Act (2002).** The NBA is a Statutory, Autonomous Body and it performs facilitative, regulatory and advisory function for the Government of India on issues of conservation, sustainable use of biological resources and fair and equitable sharing of benefits arising out of the use of biological resources.

NATIONAL LAKE CONSERVATION PLAN (NLCP) Ministry of Environment and Forests has been implementing the National Lake Conservation Plan (NLCP) since 2001 for conservation and management of polluted and degraded lakes in urban and semi-urban areas.

NATIONAL GANGA RIVER BASIN AUTHORITY (NGRBA) was constituted on February 2009 under the **Environment (Protection) Act, 1986.**

- The NGRBA is a **planning, financing, monitoring and coordinating body of the centre and the states**.
- The objective of the NGRBA is to ensure effective abatement of pollution and conservation of the river Ganga by adopting a river basin approach for comprehensive planning and management.
- The Authority **has both regulatory and developmental functions**. The Authority will take measures for effective abatement of pollution and conservation of the river Ganga in keeping with sustainable development needs.

WILDLIFE TRUST OF INDIA NGO founded in 1998 with aim to conserve nature, especially endangered species and threatened habitats, in partnership with communities and governments.

- The Wildlife Trust of India (WTI) is committed to the protection of India's wildlife; it achieves this by working in partnership with local communities and governments on a range of projects, from **species rehabilitation to the prevention of the illegal wildlife trade.**

United Nations Conference On Environment And Development (UNCED) Also known as the Rio Summit, Rio Conference, Earth Summit held in Rio de Janeiro in June 1992. The issues addressed included:

- Systematic scrutiny of patterns of production — particularly the production of toxic components, such as lead in gasoline, or poisonous waste including radioactive chemicals
- Alternative sources of energy to replace the use of fossil fuels which are linked to global climate change
- New reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and the health problems caused by polluted air and smog • The growing scarcity of water

The Earth Summit resulted in the following documents:

- Rio Declaration on Environment and Development • Agenda 21 • Forest Principles

Moreover, two important legally binding agreements
1. Convention on Biological Diversity
2. Framework Convention on Climate Change (UNFCCC).

Agenda 21 is an action plan of the United Nations (UN) related to sustainable development. It is 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. ***The number 21 refers to an agenda for the 21st century***.

Agenda 21 for culture

- During the first World Public Meeting on Culture, held in Porto Alegre, Brazil in 2002, it came up with the idea to draw up document guidelines for local cultural policies, a document comparable to what Agenda 21 meant in 1992 for environment.
- The Agenda 21 for culture is the first document with worldwide mission that advocates establishing the groundwork of an undertaking by cities and local governments for cultural development.

Rio +20 is the short name for the United Nations Conference on Sustainable Development which took place in Rio de Janeiro, Brazil in June 2012 – twenty years after the landmark 1992 Earth Summit in Rio.

- At the Rio+20 Conference, world leaders, along with thousands of participants from the private sector, NGOs and other groups, came together. The official discussions focussed on two main themes:

1. how to build a green economy to achieve sustainable development and lift people out of poverty; and
2. how to improve international coordination for sustainable development.

- AT Rio+20, more than $513 billion was pledged to build a sustainable future. It signaled a major step forward in achieving the future we want.

Convention on Biological Diversity (CBD) is a Legally binding Convention recognized for the first time, that the conservation of biological diversity is "a common concern of humankind" and is an integral part of the development process. The agreement covers all ecosystems, species, and genetic resources.
Three main goals:

- The conservation of biodiversity
- Sustainable use of the components of biodiversity
- Sharing the benefits arising from the commercial and other utilization of genetic resources in a fair and equitable way.

Cartagena Protocol on Biosafety to the Convention on Biological Diversity clearly recognizes these twin aspects of modern biotechnology.
1. Access to and transfer of technologies
2. Appropriate procedures to enhance the safety of biotechnology technologies.
Objective
Is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements.

- The Cartagena Protocol on Biosafety is an **additional agreement to the Convention on Biological Diversity**.
- The Protocol establishes procedures for regulating the import and export of LMOs from one country to another.
- The Protocol also requires Parties to ensure that LMOs being shipped from one country to another are handled, packaged and transported in a safe manner.
- The shipments must be accompanied by documentation that clearly identifies the LMOs, specifies any requirements for the safe handling, storage, transport and use and provides contact details for further information.

Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity is a **supplementary agreement to the Convention on Biological Diversity.** It provides a transparent legal framework for the effective implementation of one of the three objectives of the CBD.

Objective Is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.

CoP 11 Hyderabad One of the most important outcomes of the CoP is the commitment of the Parties to double the international financial flows for Bio Diversity by 2015. This will translate into additional financial flows to the developing countries to the tune of about US $ 30 billion equivalent to about Rs. 1,50,000 crore over the next 8 years.

- ***India has committed US $50 million towards strengthening the institutional mechanism for biodiversity conservation in the country during its presidency of the Convention on Biodiversity (CBD) called the Hyderabad Pledge.***
- The funds will be used to enhance technical and human capabilities at the national and state-level mechanisms to attain the CBD objectives.
- The country has also earmarked funds to promote similar capacity building in developing countries. India formally took charge of the presidency of CBD from Japan for the next two years on October 8 at the inaugural of the eleventh meeting of the Conference of Parties (CoP 11) to CBD.
- India has instituted together with UNDP Biodiversity Governance Awards. The first such awards were given during the CoP 11. It is now proposed to institute Rajiv Gandhi International Award for Harnessing Biodiversity for Livelihood.

RAMSAR CONVENTION ONWETLANDS is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

- It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975, and **it is the only global environmental treaty that deals with a particular ecosystem.**
- Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements, but it works very closely

with the other MEAs and is a full partner among the "biodiversity-related cluster" of treaties and agreements.

- **World Wetlands Day, 2 February every year. Number of Contracting Parties: 163**
- India became a contracting party to the Ramsar Convention in 1981 and has been implementing conservation programmes for wetlands, mangroves and coral reefs.
- **India presently has 26 sites designated as Wetlands of International Importance**.
- There is close coordination between implementing units of Ramsar with that of CBD at the national level. India took a lead role in the formulation of Ramsar guidelines on integration of wetlands into river basin management.
- The National Conservation Strategy and Policy Statements on Environment and Development (1992) and National Water Policy (2002) highlight conservation and sustainable development of wetlands.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments entered into force in 1975, and became the only treaty to ensure that international trade in plants and animals does not threaten their survival in the wild.

- Currently 176 countries are Parties to CITES.
- **CITES is administered through the United Nations Environment Programme (UNEP)**. A Secretariat, located in Geneva, Switzerland, oversees the implementation of the treaty and assists with communications between countries.
- Species for which trade is controlled are listed in one of three Appendices to CITES, each conferring a different level of regulation and requiring CITES permits or certificates.

Appendix I:

- Includes species threatened with extinction and provides the greatest level of protection, including restrictions on commercial trade. Examples include gorillas, sea turtles, most lady slipper orchids, and giant pandas.

Appendix II:

- Includes species that although currently not threatened with extinction, may become so without trade controls. It also includes species that resemble other listed species and need to be regulated in order to effectively control the trade in those other listed species.

Appendix III:

- Includes species for which a range country has asked other Parties to help in controlling international trade. Examples include map turtles, walruses and Cape stag beetles.
- **Until CoP13, these meeting were held every two years; since then, CoPs are held every three years.**

TRAFFIC: THE WILDLIFE TRADE MONITORING NETWORK is a joint conservation programme of WWF and IUCN. It was established in 1976 by the **Species Survival Commission of IUCN**, principally as a response to the entry into force during the previous year of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

- TRAFFIC is an international network, consisting of TRAFFIC International, based in Cambridge, UK with offices on five continents. Since its founding, TRAFFIC has grown to become the world's largest wildlife trade monitoring programme, and a global expert on wildlife trade issues.
- This NGO undertakes its activities in close collaboration with governments and the (CITES) Secretariat.

Vision Is of a world in which trade in wild animals and plants will be managed at sustainable levels without damaging the integrity of ecological systems and in such a manner that it makes a significant contribution to human needs, supports local and national economies and helps to motivate commitments to the conservation of wild species and their habitats.

COALITION AGAINST WILDLIFE TRAFFICKING (CAWT) aims to focus public and political attention and resources on ending the illegal trade in wildlife and wildlife products. Initiated in 2005, CAWT is a unique voluntary public private coalition of like-minded governments and organizations sharing a common purpose.

CAWT is leveraging the combined strengths of government and nongovernmental partners to:

- Improve Wildlife Law Enforcement by expanding enforcement training and information sharing and strengthening regional cooperative networks.
- Reduce consumer demand for illegally traded wildlife by raising awareness of the impacts of illegal wildlife trade on biodiversity and the environment, livelihoods, and human health; its links to organized crime; and the availability of sustainable alternatives.
- Catalyze high-level political will to fight wildlife trafficking by broadening support at the highest political levels

for actions to combat the illegal trade in wildlife. The Coalition complements and reinforces existing national, regional and international efforts, including the work of the Convention on International Trade in Endangered Species, which monitors and regulates international trade in endangered and threatened species and their derivatives. **The CAWT organization is not directly involved in any enforcement activities.**

THE INTERNATIONAL TROPICAL TIMBER ORGANIZATION (ITTO) is an intergovernmental organization, under UN (1986) promoting the conservation and sustainable management, use and trade of tropical forest resources. Its **members represent about 80% of the world's tropical forests and 90% of the global tropical timber trade.**

- Like all commodity organizations it is concerned with trade and industry, but like an environmental agreement it also pays considerable attention to the sustainable management of natural resources.
- It manages its own program of projects and other activities, enabling it to quickly test and operationalize its policy work.
- ITTO develops internationally agreed policy documents to promote sustainable forest management and forest conservation and assists tropical member countries to adapt such policies to local circumstances and to implement them in the field through projects.
- In addition, ITTO collects, analyses and disseminates data on the production and trade of tropical timber and funds a range of projects and other action aimed at developing industries at both community and industrial scales.

UNITED NATIONS FORUM ON FORESTS (UNFF) was established by The **Economic and Social Council of the United Nations (ECOSOC)** in October 2000 as a subsidiary body with the main objective to promote "the management, conservation and **sustainable development of all types of forests and to strengthen long-term political commitment to this end" based on Rio Declaration, the Forest Principles, Chapter 11 of Agenda.** The Forum has universal membership, and is composed of all Member States of the United Nations and specialized agencies.

Principal Functions

- To facilitate implementation of forest-related agreements and foster a common understanding on sustainable forest management;
- To provide for continued policy development and dialogue among Governments, international organizations, including major groups, as identified in Agenda 21 as well as to address forest issues and emerging areas of concern in a holistic, comprehensive and integrated manner,
- To enhance cooperation as well as policy and programme coordination on forest-related issues
- To foster international cooperation and
- To monitor, assess and report on progress of the above functions and objectives
- To strengthen political commitment to the management, conservation and sustainable development of all types of forests.
- Enhance the contribution of forests to the achievement of the internationally agreed development goals, including the Millennium Development Goals, and to the implementation of the Johannesburg Declaration on Sustainable Development and the Plan of Implementation of the World Summit on Sustainable Development, bearing in mind the Monterrey Consensus of the International Conference on Financing for Development;
- Encourage and assist countries, including those with low forest cover, to develop and implement forest conservation and rehabilitation strategies, increase the area of forests under sustainable management and reduce forest degradation and the loss of forest cover in order to maintain and improve their forest resources with a view to enhancing the benefits of forests to meet present and future needs, in particular the needs of indigenous peoples and local communities whose livelihoods depend on forests;
- Strengthen interaction between the UN Forum on Forests and relevant regional and subregional forest-related mechanisms, institutions and instruments, organizations and processes, with participation of major groups.

International Union for Conservation of Nature and Natural Resources (IUCN) was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France. **Vision** Just world that values and conserves nature.

Mission **To influence, encourage and assist societies throughout the world to conserve the integrity and diversity** of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. IUCN supports scientific research, manages field projects globally and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy IUCN Members include both States and non-governmental organizations. ***A neutral forum for governments, NGOs, scientists, business and local communities to find practical solutions to conservation and development challenges***.

Priority Areas of IUCN • Biodiversity • Climate change • Sustainable energy • Human well-being • Green economy

THE STOCKHOLM CONVENTION ON POP was adopted at a Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden and entered into force on 17 May 2004,

POPs

Persistent Organic Pollutants (POPs) are organic chemical substances, that is, they are carbon-based. They possess a particular combination of physical and chemical properties such that, once released into the environment, they:

- remain intact for exceptionally long periods of time (many years);
- become widely distributed throughout the environment as a result of natural processes involving soil, water and, most notably, air;
- accumulate in the fatty tissue of living organisms including humans, and are found at higher concentrations at higher levels in the food chain; and
- are toxic to both humans and wildlife.

In addition, **POPs concentrate in living organisms through another process called bioaccumulation**. Though not soluble in water, POPs are readily absorbed in fatty tissue, where concentrations can become magnified by up to 70,000 times the background levels.

BASEL CONVENTION on the **Control of Transboundary Movements of Hazardous Wastes and their Disposal** was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad.

Objective To protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" - household waste and incinerator ash.

Principal aims:

- The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- a regulatory system applying to cases where transboundary movements are permissible.

Waste under the Basel Convention Annex I of the Convention, as further clarified in Annexes VIII and IX, lists those wastes that are classified as hazardous and subject to the control procedures under the Convention. Annex II of the Convention identifies those wastes that require special consideration (known as "other wastes", and which primarily refer to household wastes). Examples of wastes regulated by the Basel Convention

- Biomedical and healthcare wastes • Used oils • Used lead acid batteries • Polychlorinated Biphenyls (PCBs),
- Persistant Organic Pollutant (POPs wastes), • Thousands of chemical wastes generated by industries and other consumers

ROTTERDAM CONVENTION was adopted in 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands and entered into force on 24 February 2004.

- The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006.
- The Convention covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the PIC procedure.

Objectives:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm;
- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

United Nations Convention to Combat Desertification (UNCCD) Established in 1994, UNCCD is the sole legally binding international agreement linking environment and development to sustainable land management.

- The UNCCD is particularly committed to a bottom-up approach, encouraging the participation of local people in combating desertification and land degradation.
- **focuses on desertification, land degradation and drought (DLDD**).
- The convention aims at adaption and can, on implementation, significantly contribute to achieving the **MDGs**, as well as sustainable development and poverty reduction by means of arresting and reversing land degradation.
- The convention promotes **sustainable land management (SLM)** as solution to global challenges. Land degradation is long-term loss of ecosystem function and productivity caused by disturbances from which the land cannot recover unaided. While Sustainable Land Management is focused on changes in land cover/land use in order to maintain and enhance ecosystems functions and services.

INTERNATIONAL WHALING COMMISSION is the global intergovernmental body charged with the conservation of whales and the management of whaling with headquarters in Cambridge, UK. It was set up under the **International Convention for the Regulation of Whaling** which was signed in Washington DC on 2nd December 1946

Preamble To provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry.

- To keep under review and revise as necessary the measures laid down in the Schedule to the Convention which govern the conduct of whaling throughout the world.
- These measures, among other things, provide for the complete protection of certain species; designate specified areas as whale sanctuaries; set limits on the numbers and size of whales which may be taken; prescribe open and closed seasons and areas for whaling; and prohibit the capture of suckling calves and female whales accompanied by calves.
- The compilation of catch reports and other statistical and biological records is also required.
- **In 1986 the Commission introduced zero catch limits for commercial whaling**. This provision is still in place today, although the Commission continues to set catch limits for aboriginal subsistence whaling.

VIENNA CONVENTION for the Protection of the Ozone Layer adopted in the year 1985 and entered into force in 1988.

- **The Montreal Protocol on Substances that Deplete the Ozone Layer** was designed to reduce the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer.
- India became a Party to the Vienna Convention for the Protection of Ozone Layer on 19 June 1991 and the Montreal Protocol on substances that deplete the ozone layer on 17 September 1992. Consequently, it ratified the Copenhagen, Montreal and Beijing Amendments in 2003.
- A detailed India Country Programme for phase out of ODS was prepared in 1993 to ensure the phase out of ODS according to the national industrial development strategy, without undue burden to the consumers and the industry and for accessing the Protocol's Financial Mechanism in accordance with the requirements stipulated in the Montreal Protocol.
- **The Ministry of Environment and Forests established an Ozone Cell and a steering committee on the Montreal Protocol to facilitate implementation of the India Country Programme for phasing out ODS production by 2010.**
- In order to meet the objectives of the Protocol, the Indian government has granted full exemption from payment of Customs and Central Excise Duties on import of goods designed exclusively for non-ODS technology.
- India has also been facilitating implementation of the Montreal Protocol in South and South East Asia and the Pacific regions.

KIGALI AGREEMENT

- 28th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer held in Kigali, Rwanda **amended the 1987 Montreal Protocol to phase out Hydrofluorocarbons (HFCs).**
- HFCs - though they are greenhouse gases like carbon dioxide, methane and nitrous oxide - are not dealt with under the Paris Agreement but under the Montreal Protocol.
- **The elimination of HFCs could reduce global warming by 0.5 degrees by 2100, according to a 2015 study by the Institute for Governance and Sustainable Development.**
- The Kigali Agreement for HFCs reduction will be binding on countries from 2019.
- Under this, 197 countries have agreed to a timeline to reduce the use of HFCs by roughly 85% of their baselines by 2045.

GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS The FAO recognizes the agricultural heritage regions of the world under a program titled Globally Important Agricultural Heritage Systems (GIAHS). The purpose of GIAHS is **to recognize "Remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations for sustainable development".**

In our country so far the following sites have received recognition under this programme:
1. Traditional Agricultural System, Koraput, Odisha
2. Below Sea Level Farming System, Kuttanad, Kerala

MINAMATA CONVENTION on Mercury is a global treaty to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. It was adopted in 2013 in Kumamoto, Japan. It also controls the trans-boundary movement of mercury. It does not include natural emissions of mercury.

The Minamata Convention requires that party nations:

- Reduce and where feasible eliminate the use and release of mercury from artisanal and small-scale gold mining.
- Control mercury air emissions from coal-fired power plants, coal-fired industrial boilers, certain non-ferrous metals production operations, waste incineration ,and cement production.
- Phase-out or take measures to reduce mercury use in certain products such as batteries, switches, lights, cosmetics, pesticides and measuring devices, and create initiatives to reduce the use of mercury in dental amalgam.
- Phase out or reduce the use of mercury in manufacturing processes such as chlor-alkali production, vinyl chloride monomer production, and acetaldehyde production.
- In addition, the Convention addresses the supply and trade of mercury; safer storage and disposal, and strategies to address contaminated sites.
- The Convention includes provisions for technical assistance, information exchange, public awareness, and research and monitoring. It also requires Parties to report on measures taken to implement certain provisions. The Convention will be periodically evaluated to assess its effectiveness in meeting its objective of protecting human health and the environment from mercury pollution. The Minamata Convention entered into force on August 2017.