UNIT-2: Natural Resources

- Natural Resources: Introduction, Classification.
- Water Resources; Availability, sources and Quality Aspects, Water Borne and Water Induced Diseases, Fluoride and Arsenic Problems in Drinking Water.
- Mineral Resources; Material Cycles; Carbon, Nitrogen and Sulfur cycles.
- Energy Resources; Conventional and Non-conventional Sources of Energy.
- Forest Resources; Availability, Depletion of Forests, Environment impact of forest depletion on society.

Handout

- Anything which may have some functions not only to satisfy human demand at a given end but also to ensure preservation of biosphere should be considered as resource. - Earth Summit (1992)
- Classification of Natural Resources Based on Origin:
  a. Biotic Resources- Biotic natural resources come from organic matter or living things.
  b. Abiotic Resources- Abiotic natural resources come from non-living things or inorganic matter including the lithosphere, atmosphere, and hydrosphere.
- Classification of Natural Resources Based on Development:

a. Potential Resources- These are resources that are known to exist, have not been quantified and can be used for future use.
b. Reserved Resources- These have been identified and quantified but have not been harnessed because they are being reserved for future use.
c. Stock Resources- These have been discovered, quantified but have not been harnessed due to insufficient technologies.
b. Actual Resources- These are resources that have been discovered, quantified, harnessed, and are being used.

- Classification Based on Availability/Exhaustibility
  a. Renewable Resources: These resources can be replenished.
  b. Non-renewable Resources: These resources are limited and can be exhausted.

- Water is renewable resource. It may change its forms but quantity of water on earth has remained same for millions of years. Water is available as groundwater and surface water.
  - Groundwater: India's groundwater resources are almost ten times its annual rainfall. Surface water: There are 14 major, 44 medium and 55 minor river basins in the country.
  - There is decline in ground and surface water due to overpopulation, deforestation etc.
  - Water quality refers to the measure of the suitability of water for any specific use or process. It is determined by various physical, chemical, and biological characteristics present in the water such as pH, ions, temperature, etc.
  - Waterborne diseases are illnesses caused by microscopic organisms, like viruses and bacteria that are ingested through contaminated water or by encountering feces.
  - Water induced Diseases are due to standing water (caused by heavy rainfall or overflow of rivers) that can act as breeding sites for mosquitoes and these vectors spread diseases by biting humans.
  - World Health Organization has regulated the upper limit for fluoride in drinking water to be 1.5 mg/L while different countries have set their standards according to their circumstances.

- Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems, and chronicle issues.
- The Nalgonda Technique uses aluminum sulphate (a coagulant normally used for water treatment) to flocculate fluoride ions present in the drinking water.
- Arsenic contamination in water leads to arsenicosis, with cancer of skin, bladder, kidney or lung or diseases of skin (colour changes, and hard patches on palms and soles), or blood vessels of legs and feet.
- Methods to remove arsenic from drinking water include adsorption-co-precipitation using iron and aluminum salts, adsorption on activated alumina, activated carbon, and activated bauxite, oxidation followed by filtration.
- A 'Mineral Resource' is a concentration or occurrence of material of intrinsic economic interest in or on the earth's crust in such form, quality, and quantity that there are reasonable prospects for eventual economic extraction.
- Material cycle or Biogeochemical cycles mainly refer to the movement of nutrients and other elements between biotic and abiotic factors.
- Nutrient cycling involves the movement of nutrients during various biological processes between biotic and abiotic components of the ecosystem & also maintains balance of nutrients in the environment.
- The energy resources can be classified as Conventional and Non-conventional sources of energy.
- Conventional sources of energy are the natural energy resources which are present in a limited quantity and are being used for a long time.
- Non-conventional sources of energy are the energy sources which are continuously replenished by natural processes. These cannot be exhausted easily, can be generated constantly so can be used again and again, e.g. solar energy.
- A forest can be defined as a biotic community predominant of trees, shrubs or any other woody vegetation usually in a closed canopy.
- The forests have protective, productive, recreational, regulatory functions & development functions.
- Deforestation refers to the loss of forest cover; land that is permanently converted from forest to agricultural land, golf courses, and cattle pasture, home, lakes, or desert. The FAO (Food and Agriculture Organization of the UN) defines tropical deforestation as “change of forest with depletion of tree crown more than 90%” and depletion of forest tree crown cover less than 90% is considered forest degradation.
- Joint Forest Management (JFM) is an informal arrangement between local communities and the forest department began in 1972, in the Midnapore district of West Bengal. Under JFM schemes, forest protection communities (FPCs) from local community members are formed.
- The biodiversity refers to the variety of living organisms (flora and fauna).

- Biological diversity deals with the degree of nature's variety in the biosphere. This variety can be observed at three levels i.e., genetic, species and ecosystem.
- There are three perspectives measuring of diversity at the level of community. These are Alpha diversity, beta diversity and gamma diversity.
- There are various threats to biodiversity like habitat loss, hunting, poaching etc. so it needs to be conserved. The conservation can be-
  - (a) In situ conservation: Conserving a species in its own natural environment by creating biosphere reserves, national parks, and wildlife sanctuaries.
  - (b) Ex situ conservation: Conserving the species outside the natural habitat in a carefully controlled situation, such as botanical garden for plants or zoological parks for animals, gene banks etc.

Natural Resources

Anything which may have some functions not only to satisfy human demand at a given end but also to ensure preservation of biosphere should be considered as resource. - Earth Summit (1992)

A. **Classification of Natural Resources Based on Origin**

Biotic Resources: Biotic natural resources come from organic matter or living things. Examples include fossil fuels, etc. Fossil fuels form part of the biotic natural resources because they are formed through the decay of living organisms that existed millions of years ago.
Abiotic Resources: These resources come from non-living things or inorganic matter including the lithosphere, atmosphere, and hydrosphere. The abiotic natural resources are air, water, sunlight, and minerals (like iron, gold, silver, copper, titanium, and diamonds).

B. **Classification of Natural Resources Based on Development**

Potential Resources: These are resources that are known to exist, have not been quantified and can be used for future use. For instance, wind energy exists in certain areas but has not been used to generate energy. **Example:** wind energy, solar energy etc.

Reserved Resources: They are natural resources that have been identified and quantified but have not been harnessed because they are being reserved for future use. **Example**: Rivers.

Stock Resources: These are resources that have been discovered, quantified but have not been harnessed due to insufficient technologies. **Example**: Hydrogen as fuel.

Actual Resources: These are resources that have been discovered, quantified, harnessed, and are being used. **Examples:** Crude oil, forest.

Classification Based on Availability/Exhaustibility-
Renewable Resources: These natural resources can be replenished. The rate at which they can be replenished exceeds rate at which they are being used up. Examples include solar energy, etc
Non-renewable Resources: Resources in this category are limited and can be exhausted. Their formation takes millions of years. Examples include fossil fuels.

Renewable Resources	**Non-Renewable Resources**
These can be renewed again and again in nature.	Once completely consumed, these cannot be renewed.
These are available in infinite quantity.	These are available in limited stock.
Sustainable in nature.	Exhaustible in nature.
Environment-friendly.	Less environment friendly.
Replenish quickly	Replenish very slowly (after billions of years) or do not replenish naturally at all
Renewable resources include biotic and abiotic resources like plants, animals, water, sunlight etc.	Non-renewable resources include fossil fuel like coal, oil, and natural gas, and minerals like iron, copper etc.

WATER RESOURCES

- The United Nations has recognized access to water as a basic human right, stating that water is a social and cultural good, not merely an economic commodity.

- Water covers 75% of earth's surface out of which 97 is locked in seas or oceans, 3% is fresh water (aprox 2 % in polar ice caps, < 1% available as surface water (rivers, streams, lakes) and ground water.

- Water is renewable resource. It may change its form but quantity of water on earth has remained same for millions of years with which we have to manage ourselves.

- **Groundwater:** India's groundwater resources are almost ten times its annual rainfall. According to the Central Groundwater Board of the Government of India, the country has an annual exploitable groundwater potential of 26.5 million hectare-meters. In India nearly 85% of groundwater is used only for irrigation 9% for industries and 6% for domestic uses.

- However, according to the International Irrigation Management Institute (IIMI), the water table almost everywhere in India is falling at between one to three meters every year. Furthermore, the IIMI estimates that India is using its underground water resources at least twice as fast they are being replenished.

- Excessive ground water mining causes land subsidence, lowering of water table, Waterlogging due to excessive irrigation on poorly drained soil and saltwater intrusion.

- **Surface water:** There are 14 major, 44 medium and 55 minor river basins in the country. The major river basins constitute about 83-84% of the total drainage area. This, along with the medium river basins, accounts for 91% of the country's total drainage. India has the largest irrigation infrastructure in the world, but the irrigation efficiencies are low, at around 35%.

- **Consumption Patterns**: Today, due to increasing consumption patterns, water is becoming scarce, and this scarcity is an emerging threat to the global population. If per capita water availability is any indication, "water stress" is just beginning to show in India. This index is based on the minimum per capita level of water required to maintain an adequate quality of life in a moderately developed arid zone country.

Reasons for decline of ground water

- Population growth at an unprecedented and unsustainable rate; many more areas are expected to experience this imbalance soon.

- Increased population leads to enormous demands on the world's limited freshwater supply.

- Overutilization of Surface and Groundwater occurs at various levels.
- Industries to maximize short-term economic gains does not bother its liquid waste and releases it into streams, rivers, and the sea.
- Deforestation: The destruction of forests influences the regulation of natural water cycle. The removal of dense and uniform cover over the hilly zones leads to occurrence of floods in drainage basins. Nations situated in tropical climates including India experience disastrous floods caused by the indiscriminate deforestation of the slopes above the valleys.
- Hydropower generation: Large amount of water is used for generating power which otherwise used for human needs.
- Rain falls: The erratic and inadequate rainfall results in reduction in storage in ground water reservoirs.

WATER QUALITY

Water quality refers to the measure of the suitability of water for any specific use or process. It is determined by various physical, chemical, and biological characteristics present in the water such as pH, ions, temperature, etc. The concentration of these characteristics determines whether the water quality is suitable for drinking to conduct life processes, industrial use or even for the natural processes that occur in the environment. Water quality is also determined by the concentration of dissolved solids, organic, and inorganic particles present in the water as well as the physical characteristics of water.

Water Quality Indicators

While determining what the water quality is, certain measurements need to be made to determine whether the quality is suitable for a particular use. The key components that act as water quality indicators are:

- **Dissolved Oxygen**- It is the amount of oxygen that is present in water or the amount of oxygen available to living aquatic organisms. The levels of dissolved oxygen, or DO, in the water indicate whether it is suitable for drinking or for aquatic animals to live in. healthy water should have DO concentration above 6.5- 8 mg/L. Water at lower temperatures should have higher % of dissolved oxygen while warmer, polluted waters will have lower % of dissolved oxygen.

- **Temperature-** All aquatic animals require a certain range of temperature i.e. optimal temperature range which is generally between 5- 25^0C The temperature of the water affects the amount of DO present, the kinds of living organisms present, pollution as well as diseases.

- **pH-** The normal or neutral pH level of water is 7, pH above 7 indicates the water is alkaline in nature, while pH below 7 indicate that the water is acidic. Extreme levels on the pH scale affect all kinds of living organisms.

- **Specific Conductance-** Specific conductance refers to the ability of water to conduct electric current. Organic and inorganic materials like dissolved solids, chloride, sodium, calcium, etc., temperature and the geology of the area affects the conductivity of the water. The higher the concentration of ions in the water, the higher its ability to conduct electricity.

- **Nutrients-** The plants and animals found in water bodies require macro nutrients like nitrogen, phosphorus, calcium, magnesium, sulfur and potassium while iron, manganese, boron, copper, zinc, chlorine and cobalt are micro nutrient.
  Nutrients can be found in different forms, whether organic, inorganic, or dissolved. Large amounts of nitrogen in the form of nitrates result in an increase in algal growth (algal bloom) and accumulation of toxicity in food chain.

- **Industrial Chemicals-** There are certain kinds of industrial chemicals present in water that are used for various agricultural, manufacturing, pharmaceutical and chemical processes. However, most of the chemicals can become toxic for aquatic ecosystems.

➢ **Dams**: It can be unequivocally stated that dams have made significant contributions to human development and the benefits derived from them have been considerable. But large dams have proved to cause catastrophic environmental damage. Hence an attempt has been made to construct small dams. Multiple small dams have less impact on the environment.

Benefits: Dams ensure a year-round supply of water for domestic use and provide extra water for agriculture, industries and hydropower generation. Large dams are designed to control floods and to help the drought prone areas, with supply of water.

Problems: large dams alter river flow, change nature' flood control mechanisms such as wetlands and flood plains and destroy the lives of local people and the habitats of wild plant and animal species. Dam construction and submersion leads to significant loss of arable farmland and forest. Siltation of reservoirs, water logging in surrounding lands reduces agricultural productivity, deforestation and loss of biodiversity is also there.

Water borne and Water Induced Diseases

Waterborne diseases are illnesses caused by pathogens (microorganisms like viruses, bacteria, and protozoan) or due to some chemicals that are ingested through contaminated water or water encountering feces. There is an increased risk of infection of water-borne diseases contracted through direct contact with polluted waters, such as wound infections, skin infection, ear, nose, and throat infections. These are of two types-

(a) Pathogenic- illnesses caused by pathogens i.e. disease-causing microorganisms like viruses, bacteria, and protozoan. Example- Bacteria- Cholerae, Typhoid, Virus- Hepatitis A, polio, Protozoa- Dysentery. The route of exposure is gastro- intestinal.

(b) Due to chemical- Water borne diseases may be caused due to ingestion of chemical contaminated potable water e.g., arsenicosis, fluorosis etc

Fluoride and Arsenic problem in Drinking water

Fluoride contamination has become a considerable threat to our society worldwide. Fluoride in drinking water is primarily due to rich fluoride soil, volcanic activity, grasses and grains, and anthropogenic reasons. World Health Organization has regulated the upper limit for fluoride in drinking water to be 1.5 mg/L while different countries have set their standards according to their circumstances.

Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems, and chronicle issues. In extreme conditions, it could adversely damage the heart, arteries, kidney, liver, endocrine glands, neuron system, and several other delicate parts of a living organism.

Solution- The Nalgonda Technique: It can remove more than 90% of fluoride in water. The process uses aluminum sulfate (a coagulant normally used for water treatment), lime and bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection.

Aluminium salt may be added as aluminium sulphate (alum) or aluminium chloride or combination of these two. It is responsible for removal of fluoride from water.

The first community plant for removal of fluoride from drinking water was constructed in the district of Nalgonda in Andhra Pradesh, in the town of Kathri. The technology was developed by National Environmental Engineering Research Institute (NEERI), Nagpur in 1961.

Arsenic is introduced into soil and groundwater during weathering of rocks and minerals followed by subsequent leaching and runoff. It can also be introduced into soil and groundwater from anthropogenic sources.

Long-term intake of arsenic contaminated water leads to arsenic poisoning or arsenicosis, with cancer of skin, bladder, kidney or lung or diseases of skin (colour, changes, and hard patches on palms and soles), or blood vessels of legs and feet.

Various treatment methods have been adopted to remove arsenic from drinking water. These methods include 1) adsorption-coprecipitation using iron and aluminum salts, 2) adsorption on activated alumina, activated carbon, and activated bauxite, 3) reverse osmosis, 4) ion exchange and 5) oxidation followed by filtration.

Prevention of Water borne diseases:

- Store water in a clean vessel and use boiled and cooled water for drinking.
- RO filtration, Activated Alumina Defluoridation filter, Distillation Filtration
- Use of halazone tablets (Chlorine tablets) for household use wherever possible. A single tablet of 0.5 gm is sufficient to disinfect 20 liters of water.

Water induced Diseases: diseases for which water is a cause (as habitat) of pathogen and transmitted through vector (parasite or insect) are called as water induced diseases such as dengue, malaria.

Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes and other insects. Flooding may initially flush out mosquito breeding, but it comes back when the waters recede.

The risk of outbreaks is greatly increased by complicating factors-

(i) Increased exposure to mosquitoes while sleeping outside, a temporary pause in disease control activities, overcrowding.

(ii) changes in the habitat which promote mosquito breeding such as landslide, deforestation, river damming, and rerouting.

Prevention of Vector borne water induced diseases:

- Chemical Control: Use of Indoor Residual Spray (IRS) with insecticides recommended.
- Aerosol space spray during daytime.
- Malathion fogging during outbreaks.
- Use of mosquito repellent creams, liquids, coils, mats etc.
- Wearing clothes that cover maximum surface area of the body.
- Use of chemical larvicides like Abate in potable water.

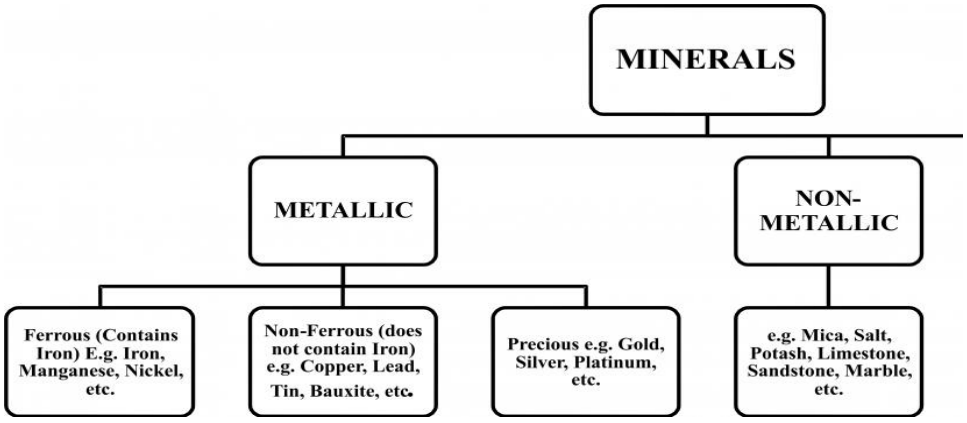
MINERAL RESOURCES

A mineral is a naturally occurring inorganic substance, that is usually solid and has a crystal structure. These are the natural resources which cannot be renewed.

- The calcium, phosphorous, sodium, chlorine and sulphur are the major minerals in the animals.
- The minor minerals in the animals are iron, copper, cobalt, zinc, fluorine, and selenium.
- The minerals in the plants are divided into the macro and micronutrients.

The macro nutrients consist of calcium, magnesium, sulphur and iron.

The micronutrients consist of manganese, cobalt, zinc and chlorine.



Uses of Minerals-

(i) Minerals are used for constructing houses.
(ii) Manufacturing machines and automobiles
(iii) Ornamenting body parts.
(iv) Various defense activities such as- Making weapons, Generating electricity, Manufacturing machines, For industries.
(v) For petroleum industry – Sulphur, fertilizer industry and agricilture - phosphate, sulphate and Sulphur, nitrates.
(vi) Medicine – gold, iron and aluminium.

Overexploitation of mineral resources cause-

1. Rapid depletion of high-grade mineral deposits.
2. Wastage of mineral wealth.
3. Pollution of environment from mining.
4. Pollution caused by heavy energy requirement of mining industry.

Conservation of minerals- Important steps may be taken to make these deposits last longer are:

1. Making Finished Products Long Lasting
2. Re-Use and Re-Cycling of Metals & Use of Cheaper Substitutes
3. More Efficient Recovery of Materials from Minerals
4. Search for New Deposits & Protection of existing mineral deposits.

MATERIAL / NUTRIENT / BIOGEOCHEMICAL CYCLES

"Biogeochemical cycles mainly refer to the movement of nutrients and other elements between biotic and abiotic factors" The term biogeochemical is derived from bio meaning **biosphere**, geo meaning the geological components and chemical meaning the elements that move through a cycle.

There are two important components of a biogeochemical cycle.

(1) **Reservoir pool** - atmosphere or rock, which stores large amounts of nutrients.

(2) **Cycling pool or compartments of cycle**-They are relatively short storages of carbon in the form of plants and animals.

Types of Biogeochemical Cycles- Biogeochemical cycles are divided into two types based on the nature of the reservoir.

Gaseous cycles – where the reservoir is the atmosphere or hydrosphere includes Carbon, Oxygen, Nitrogen, and the Water cycle.

Sedimentary cycles – where the reservoir is the Earth's crust e.g. sulphur, phosphorus, Rock cycle, etc.

CARBON CYCLE

- carbon dioxide present in the atmosphere is the source of carbon and its different forms. It is highly soluble in water; therefore, oceans also contain large quantities of dissolved carbon dioxide. The carbon cycle consists of following steps-

1. **Photosynthesis:** Green plants in the presence of sunlight utilize CO_2 in the process of photosynthesis and convert it into organic matter (food) and release oxygen.
2. **Assimilation**- A part of the food made through photosynthesis is used by plants for their own metabolism and the rest is stored as their biomass which is available to various herbivores, including human beings and microorganisms as food.
3. **Respiration:** CO_2 is released back into of the atmosphere through the process of respiration. Respiration is carried out by all living organisms. It is a metabolic process where food is oxidized to liberate energy, CO_2, and water. The energy released from respiration is used for carrying out life processes by living organism (plants, animals, decomposers etc.).
4. **Decomposition and Sedimentation –** These animals and plants eventually die, and upon decomposing, carbon is released back into the atmosphere through decomposition. Some of the carbon that is not released back into the atmosphere become fossil fuels.
5. **Combustion:** Burning of biomass and fossil fuel releases carbon dioxide into the atmosphere.

6. **Impact of Anthropogenic activities**: The global carbon cycle has been increasingly disturbed by human activities particularly since the beginning of industrial era. Large scale deforestation and ever-growing consumption of fossil fuels by growing numbers of industries, power plants and automobiles are primarily responsible for increasing emission of carbon dioxide.

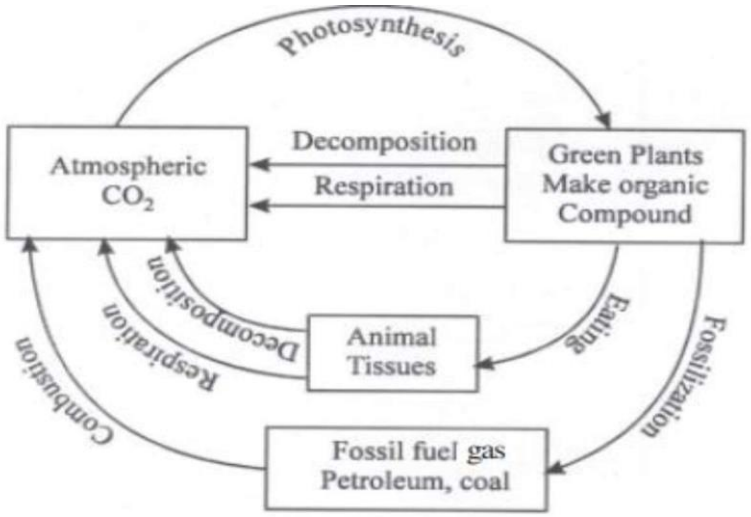
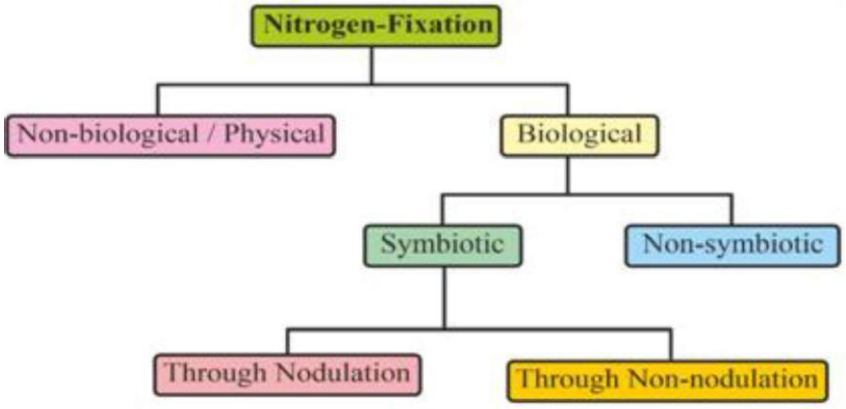


Fig. CARBON CYCLE

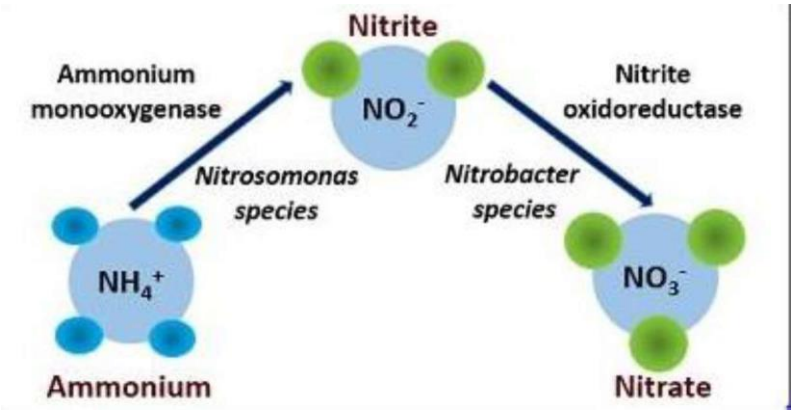
Nitrogen cycle

Nitrogen is an essential component of protein and required by all living organisms including human beings. Our atmosphere contains nearly 78% of nitrogen but it can not be used directly by living organisms. Cycling of nitrogen is vitally important for all living organisms. There are five main processes which essential for nitrogen cycle are elaborated below.

1. **Nitrogen fixation**: In this process atmospheric nitrogen is converted into **related nitrogenous compounds** like ammonia and ammonium (NH^+) in the soil or aquatic systems. Atmospheric nitrogen can be fixed by the following three methods: -
   (i) Atmospheric fixation: Lightening, combustion, and volcanic activity help in the fixation of nitrogen.
   (ii) Industrial fixation: At high temperature (400^{o}C) and high pressure (200 atm.), molecular nitrogen is broken into atomic nitrogen which then combines with hydrogen to form ammonia.
   (iii) Bacterial (Biological) fixation: There are two types of bacteria-
   (a) **Symbiotic bacteria** e.g. *Rhizobium* in the root nodules of leguminous plants.
   (b) Freeliving or asymbiotic e.g. *Nostoc, Azobacter, Cyanobacteria* can combine atmospheric or dissolved nitrogen with hydrogen to form ammonia.



2. **Nitrification**: It refers to the biological process in which ammonia (NH_3) or ammonium (NH_4^+) primarily converts into nitrites (NO_2^-) and then into nitrates (NO_3^-). Nitrification is a **two-step process** mediated by specific groups of soil microorganisms.
   Nitritation: The initial step involves the oxidation of ammonia into nitrogen dioxide or nitrites. **Nitrosomonas** are the special group of bacteria that participate in nitritation.
   Nitration: It is the second phase, which facilitates the oxidation of nitrites (NO_2^-) into nitrates (NO_3^-). Nitration involves nitrite-oxidizing bacteria like **Nitrobacter** and **Nitrospira species.**



3. **Uptake & Assimilation:** In this process nitrogen fixed by plants is converted into organic molecules such as proteins, DNA, RNA etc. These molecules make the plant and animal tissue.
4. **Ammonification**: Living organisms produce nitrogenous waste products such as urea and uric acid. These waste products as well as dead remains of organisms are converted back into inorganic ammonia by the bacteria. This process is called ammonification. Ammonifying bacteria help in this process.

5. **Denitrification:** Conversion of nitrates back into gaseous nitrogen is called denitrification. Denitrifying bacteria live deep in soil near the water table as they like to live in oxygen free medium. Denitrification is reverse of nitrogen fixation.

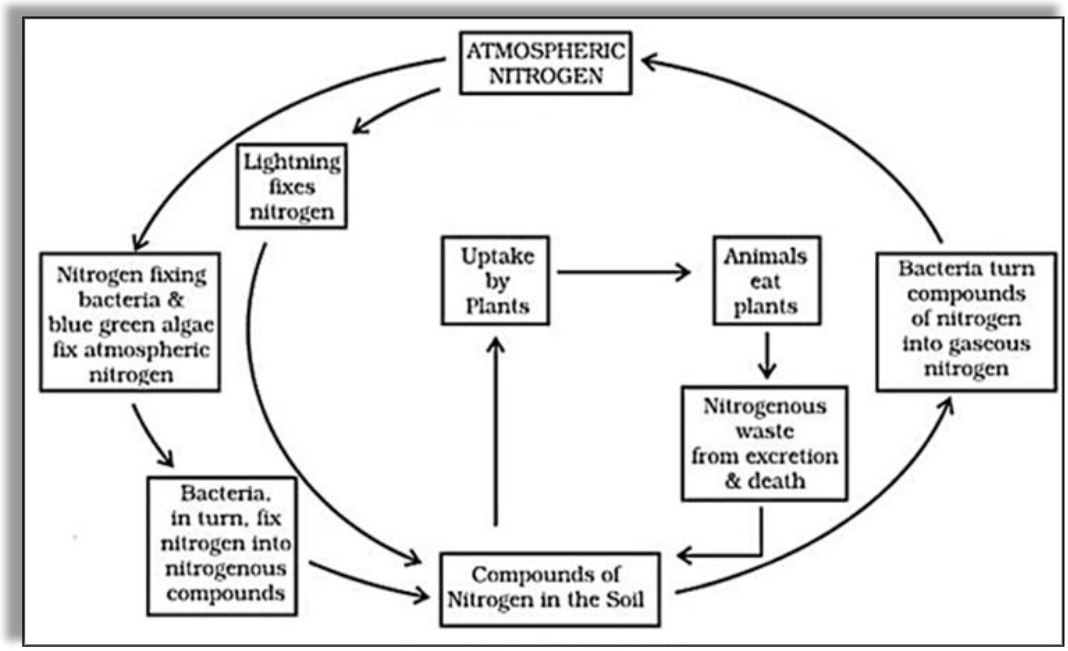


Fig. Nitrogen Cycle

SULPHUR CYCLE

Steps of the sulfur cycle are:

Mineralization of organic sulfur into inorganic forms, such as hydrogen sulfide (H_2S), elemental sulfur, as well as sulfide mineral.

Reduction of sulfate to sulfide.

Oxidation- hydrogen sulphide (H_2S) and elemental sulphur meets air and is converted into to sulphate (SO_4^{2-}).

Incorporation- Sulphates are taken up by plants and microbes and are converted into organic forms. The organic form of sulphur is then consumed by the animals through their food and thus sulphur moves in the food chain. sulfide into organic compounds.

Reduction – When the animals die, some of the sulphur is released by decomposition while some enter the tissues of microbes. sulfate (SO^{2-}_4) to sulfide. There are several natural processes such as volcanic eruptions, evaporation of water, and breakdown of organic matter that release sulphur directly into the atmosphere. This sulphur falls on earth with rainfall.

ECOLOGICAL SIGNIFICANCE OF NUTRIENT CYCLING

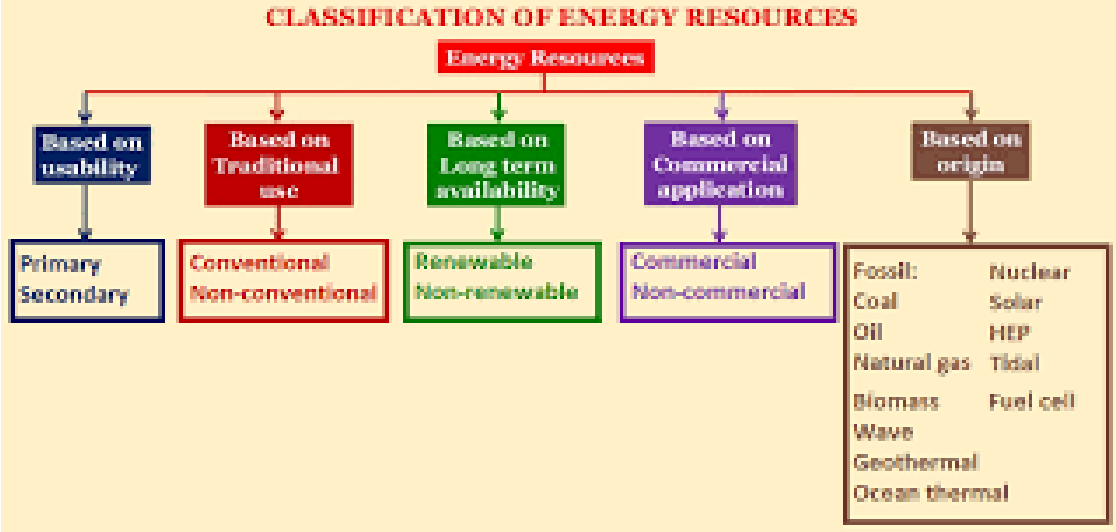
1. It tracks pragmatic movement of nutrients during various biological processes between biotic and abiotic components of the ecosystem.
2. It also maintains balance of nutrients in the environment.

ENERGY RESOURCES

Any substance or phenomenon that provides energy. Energy is-

- Index of development.
- Required for modern civilization.
- Required for basic infrastructure and to improve existing technologies.

These energy resources can be classified as-



Conventional sources of energy:

Conventional sources of energy are the natural energy resources which are present in a limited quantity and are being used for a long time. They are called non-renewable sources as once they are depleted, they cannot be regenerated at the speed which can sustain its consumption rate. They are formed from decaying matter over hundreds of millions of years e.g. fossil fuel, hydropower and nuclear energy.

These resources have been depleted to a great extent due to their continuous exploitation. It is believed that the deposits of petroleum in our country will be exhausted within few decades and the coal reserves can last for a hundred more years.

Non-conventional sources of energy:

Non-conventional sources of energy are the energy sources which are continuously replenished by natural processes. These cannot be exhausted easily, can be generated constantly so can be used again and again, e.g. solar energy, wind energy, tidal energy, biomass energy and geothermal energy etc.

The energy obtained from non-conventional sources is known as non- conventional energy. They are called renewable resources as they can be replaced through natural processes at a rate equal to or greater than the rate at which they are consumed.

Some of the key differences between conventional and non-conventional sources of energy are as follows:

Conventional sources of energy	**non-conventional sources of energy**
These sources of energy are not abundant, present in limited quantity, e.g. coal, petroleum, natural gas.	These sources of energy are abundant in nature, e.g. solar energy, wind energy, tidal energy, biogas from biomass etc.
They have been in use for a long time.	They are yet in development phase over the past few years.
They are not replenished continuously. They are formed over a million years.	They are replenished continuously by natural processes.
They can be exhausted completely due to over-consumption except for hydel power.	They cannot be exhausted completely.
They pollute the environment by emitting harmful gases and contribute to global warming.	They are environment friendly.
Heavy expenditure is involved in using and maintaining these sources of energy.	Using these sources is less expensive.

ROLE OF AN INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES

The two most damaging factors leading to the current rapid depletion of all forms of natural resources and their increasing consumption are rapid population growth and affluence. The role of an individual for conservation is as:

Energy conservation

- Turn off lights and fans as soon as you leave the room.
- Use tube lights and energy efficient bulbs that save energy rather than bulbs. A 40- watt tube light gives as much light as a 100 watt bulb.
- Keep the bulbs and tubes clean. Dust on tubes and bulbs decreases lighting levels by 20 to 30 percent.
- Switch off the television or radio as soon as the program of interest is over.
- A pressure cooker can save up to 75 percent of energy required for cooking. It is also faster.
- Keeping the vessel covered with a lid during cooking, helps to cook faster, thus saving energy.

FOREST RESOURCE

Forests are complex land ecosystems that support a wide variety of plants, trees and animals Or A forest is usually a big space covered with trees, thick vegetation, and animals living within.

India's Forest cover is 6,76,000 sq.km (20.55% of geographic area). Scientists estimate that India should ideally have 33% of its land under forests. Today we only have about 12% thus we need not only to protect our existing forests but also to increase our forest cover.

Types of forests-

Temperate forest- (a) rain forest (b) deciduous (lose their leaves at the end of season)

- Well defined seasons with winters.
- Moderate climate, temp. -30 to 30C
- Even rainfall, annual rainfall 75-150cm
- Fertile soil, moderate canopy, and moderate biodiversity.
- Trees having broad leaves

Tropical- (a) rain forest (b) deciduous (lose their leaves at the end of season)

- Greatest diversity of species, long trees (25-30m)
- Occur near equator.
- Only two seasons rainy and dry (winter is absent)
- temp. 20-25C
- Evan rainfall >2000mm annually
- Low nutrient in soil, acidic
- Form canopy little light within

Boreal forest (Taiga)-

- rain 40-100cm.
- Low temp. (freezing)
- Thin, poor, acidic soil.
- Big canopy having low light within.
- Cold tolerant flora and fauna.

Forest Functions:

I. Protective and ameliorative functions.
II. Productive functions
III. Recreational and regulatory functions
IV. Development functions

I. Protective functions

- Watershed protection, reducing the rate of surface run-off of water, Preventing flash floods and soil erosion. Producing prolonged gradual run-off and thus safeguarding against drought.
- Erosion control holding soil (by preventing rain from directly washing soil away).
- Absorption of solar heat during evapo-transpiration

II. Productive Functions

- Consumption of forest produce by local people who collect it for sustenance such as food, wood, medicinal plants, Timber for household articles and construction.
- Fiber for weaving baskets, ropes, nets, strings, etc., Sericulture for silk.
- Apiculture for rearing bees for honey (bees as pollinators)

Most of the products used for consumptive purposes and good source of income for

supporting their livelihood of forest dwelling people.

III. Recreational And regulatory Functions:

- Eco tourism.
- Maintaining nutrient cycles for plant growth.
- Maintaining the local climatic conditions.
- Regulation of water cycle.
- Developmental, Employment functions and Revenue.
- Land bank Maintaining soil nutrients and structure.

Ecological significance of forests:

1. Balances CO_2 and O_2 levels in atmosphere and act as carbon sink.
2. Regulates earth temperature and hydrological cycle.
3. Encourage seepage and reduces runoff losses, prevents drought.
4. Reduces soil erosion (roots binding), prevents siltation and landslides thereby floods.
5. Litter helps in maintaining soil fertility.
6. Safe habitat for birds, wild animals and organisms against wind, solar radiation and rain

Deforestation: Deforestation refers to the loss of forest cover for non-forest purposes i.e land that is permanently converted from forest to agricultural land, golf courses, cattle pasture, home, lakes or desert. The FAO (Food and Agriculture Organization of the UN) defines forest with depletion of tree cover more than 90 % is depletion of forest and less than 90% is considered forest degradation.

Causes for Deforestation:

1. Agriculture: Conversion of forests to agricultural land to feed growing numbers of people

2. Commercial logging: (which supplies the world market with woods such as meranti, teak, mahogany and ebony) destroys trees as well as opening up forest for agriculture. Cutting of trees for firewood and building material, the heavy lopping of foliage for fodder and heavy grazing of saplings by domestic animals like goals.

3. The cash crop economy: Raising cash crops for increased economy.

4. Mining

5. Increase in population: The needs also increase and utilize forests resources.

6. Urbanization & industrialization

7. Mineral exploration

8. Construction of dam reservoirs

9. Infrastructure development

10. Forest fires

11. Human encroachment & exploitation

12. Pollution due to acid rain

Environmental effects /Consequences of deforestation

1. Loss of habitat. -70% of land animals and plant species live in forests.

2. Loss of biodiversity - due to loss of animal and plant species.

3. Climate change - greater amount of greenhouse gases to be released into the atmosphere. Healthy forests absorb carbon dioxide from the atmosphere, acting as valuable carbon sinks.

4. Irregular water cycle – plants release water into atmosphere (transpiration) Amazon rainforest Its millions of trees work together to release moisture into the air, creating atmospheric "rivers.

5. Desertification- Most humid regions changes to desert.

6. Soil erosion–lose of fertile soil due to rainfall and wind.

7. Flooding and landslide in hilly areas.

8. fewer crops and decrease of recharge to ground water.

9. Loss of future markets for ecotourism. The value of a forest is often higher when it is left standing than it could be worth when it is harvested.

10. Deforestation can cause the climate to become extreme in nature. The occurrence and strength of floods and droughts affect the economy.

11. The stress of environmental change may make some species more susceptible to the effect of insects, pollution, disease and fire

12. Environmental pollution, climate change, Global warming etc.

Conservation: Conservation derived from two Latin words, con – together,-servare – to keep or guard measures, i.e. an act of preservation or to keep together .

Concepts in conservation

1. Restraining cutting of trees and submerging the forests.

2. Reforestation

3. Afforestation

4. Control forest diseases and forest fire.

5. Recycling forest products

6. Replacing forest products

7. Avoids diversion of forest lands for other activities through acts like Forest Conservation Act and Wildlife (protection) Act

8. Bringing awareness among people ex: Chipko movement, Appiko , NarmadaBachaoAndolan
9. Implement people's participatory programme e.g. Joint Forestry Management (JFM).

Joint Forest Management (JFM): An informal arrangement between local communities and the forest department began in 1972, in the Midnapore district of West Bengal. Under JFM schemes, forest protection communities (FPCs) from local community members are formed. They participate in restoring the green cover and protect the area from being over – exploited. Realizing this, the MoEF formulated the National Forest Policy of 1988 to give added importance to joint forest management (JFM), which co-opts the local village communities and the forest department to work together to sustainable manage our forests.

Case Study

Chipko Movement: From Barucha About 300 years ago, a ruler in Rajasthan decided to fell the 'khejri' trees in his state to create lime. Local women led by a Bishnoi woman. Amrita Devi clung to the trees to prevent the felling of the trees that formed the basis of the scarce resources on which they were dependent. The women were ruthlessly massacred. It is said that the ruler later realized his mistake. The story, however, has been remembered and was revived in the 1970s when severe tree-felling for timber in the Himalayas prompted local women, supported by people such as Sunder Lal Bahuguna and Chandi Prasad Bhat, led a people's movement to prevent deforestation by timber contractors. They called the movement the 'Chipko' movement in memory of the event during which women had clung to their trees and given up their lives.

Biodiversity

The word biodiversity refers to the variety of living organisms (flora and fauna). Biodiversity or Biological diversity is defined as the variability among all living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and ecological complexes of which they are part.

Types of Biodiversity: the biodiversity observed at three levels i.e., genetic, species and ecosystem.

Genetic diversity: Genetic diversity refers to the variation at the level of individual genes. Tremendous amount of genetic diversity exists within individual species. This genetic variability is responsible for the different characters in species e.g. rice, wheat, maize, barley, etc. Genetic diversity is the raw material from which new species arise through evolution. Today, the genetic diversity is made use to breed new crop varieties, disease resistant crops.

Species diversity: The number of species of plants and animals that are present in a region constitutes its species diversity. This diversity is seen both in natural ecosystem and in agricultural ecosystem. Some areas are richer in species than others. For example, natural undisturbed tropical forests have much greater species richness than monoculture plantations developed by the forest department for timber products.

Ecosystem diversity: There are a large variety of different ecosystem on earth, each having their own complement of distinctive inter linked species based on differences in the habitat. Ecosystem diversity can be described for a specific geographical region or a political entity such as a country, a state, or a taluk. Distinctive ecosystems include landscapes like forests, grasslands, deserts, mountains etc as well as aquatic ecosystems like rivers, lakes and seas.

Methods of measuring Biodiversity:

There are three perspectives measuring of diversity at the level of community. These are

(i) Alpha diversity, (ii) beta diversity and (iii) gamma diversity. Community diversity refers to the variations in the biological communities in which species live.

(i) Alpha diversity: indicates diversity within the community. It refers to the diversity of organisms sharing the same community or habitat. A combination of species richness and equitability / evenness is used to represent diversity within a community or habitat.

(ii) Beta diversity indicates diversity between communities. Species frequently change when habitat or community changes. There are differences in species composition of communities along environmental gradients, e.g, altitudinal gradient, moisture gradient, etc. the higher

heterogeneity in the habitats in a region or greater dissimilarity between communities exhibit higher beta diversity.

(iii) Gamma diversity refers to the diversity of the habitats over the total landscape or geographical area. The sum of alpha and beta diversities of the ecosystems is an expression of the biodiversity of landscape, which is considered as Gamma Diversity.

Biodiversity Hotspot: Areas that are rich in species diversity are called 'hotspots' of diversity and the countries with highest species richness or have a relatively large proportion of these hot spots of diversity are referred to as 'mega-diversity nations'. India is among the world's 15 nations that are exceptionally rich in species diversity. The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major eco-regions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200. It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 25 'hot spots' in the world. These hotspots harbor many rare and endangered species. Two criteria help in defining hotspots namely rich endemism and the degree of threat. To qualify as hotspots an area must contain at least 0.5 per cent or 1500 of the world' s 3, 00,000 plants species as endemics (Myers et al., 2000).

Threats to Biodiversity:

1) **Habitat loss** is mainly due to human population growth, industrialization and changes in the land use patterns, poaching of wildlife and man- wildlife conflicts. Man has begun to overuse or misuse most of these natural ecosystems.

2) **Poaching:** Specific threats to certain animals are related to large economic benefits. The skin and bones from tigers, ivory from elephants, horns from rhinos and perfume from the musk deer are extensively used abroad. Bears are killed for their gall bladders. Corals and shells are also collected for export or sold on the beaches of Chennai, Kanyakumari, and the Andaman and Nicobar Islands. Tortoises, exotic birds, and other small animals are packed into tiny containers and smuggled abroad for the pet trade. A variety of wild plants with real or sometimes, dubious medicinal values are being overharvested.

3) **Man wildlife conflicts**: Conflicting situations with wild life starts causing immense damage and danger to man. Ex: In Sambalpur, Orissa 195 humans are killed in last 5 years by elephants and in retaliation villagers killed 98 elephants and badly injured more than 30 elephants. Shrinking forest cover, human encroachment, ill and weak animals, lack of food for animals, protecting villagers by putting electric fence are the main reasons for such happenings.

4) **Pollution** alters natural habitat and biodiversity.

5) Climate change and natural disasters led to biodiversity loss.

Conservation of biodiversity is of two types i.e., *In situ* and *Ex situ.*

In situ conservation: Conserving a species in its own natural environment by creating biosphere reserves, national parks, and wildlife sanctuaries.

- **Biosphere reserves**- large, protected areas usually more than 500sq. km. it comprises of three parts core, buffer and transition. It includes conservation, development and scientific research for biodiversity.

- National parks- it is an area, strictly reserved for the development of wildlife. These are usually small reserves (100- 500 sq.km area). The emphasis is on the preservation of a single plant species or animal species.

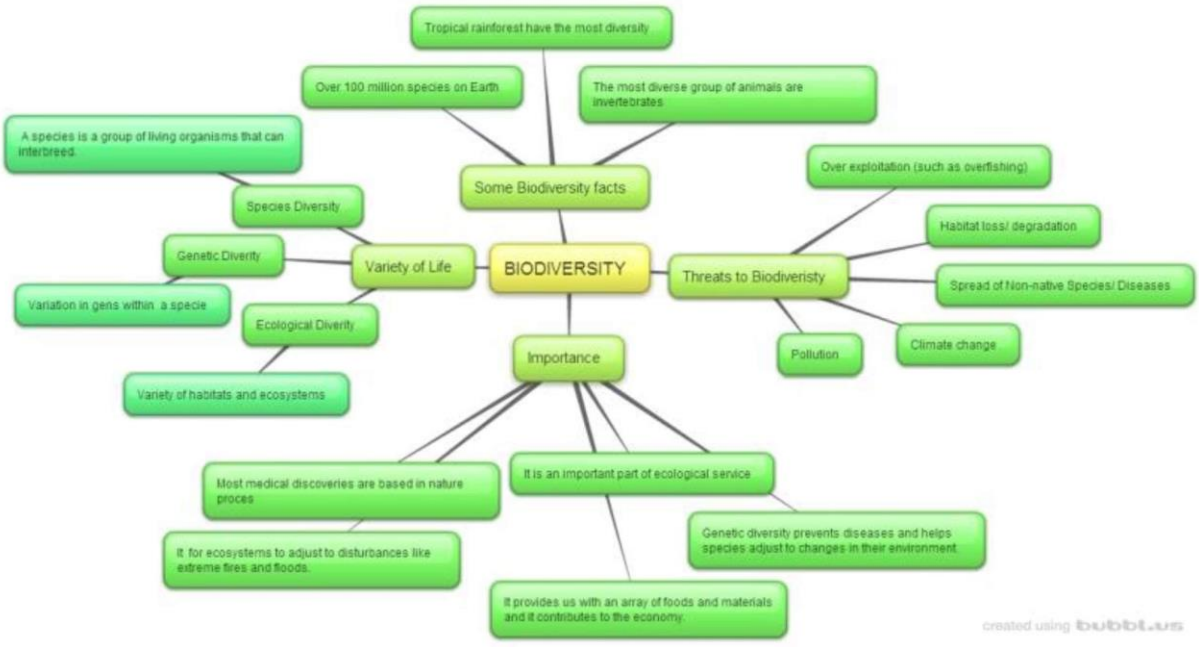
- Wildlife sanctuaries- it is a protected area which is reserved for conservation of animals. Human interference is allowed as long as they do not disturb the animals. Tourist activity is allowed e.g. Ghana bird sanctuaries, Rajasthan.

Ex situ conservation: Conserving the species outside the natural habitat in a carefully controlled situation, such as botanical garden for plants or zoological parks for animals, gene banks, seed bank, protoplasm bank, etc.

Biological Diversity act 2002:

Biological diversity is a national asset of a country; hence the conservation of biodiversity assumes greater significance. The first attempt to bring the biodiversity into the legal framework was made by way of the biodiversity bill 2000 which was passed by the Lok Sabha on 2nd December 2002 and by Rajya Sabha on the December 2002.

International day for Biological Diversity - 22nd May



UNIT 2

Short Answer Questions (2Marks/3Marks)

1. What is fluorosis?
2. What is soil erosion?
3. Write the various factors which influence the deforestation and list out the impacts of deforestation.
4. What are conventional sources of energy? Give example.
5. What are non-conventional sources of energy? Give Examples.
6. Define deforestation.
7. Write about the types of biodiversity.
8. Express how arsenic in drinking water affects human life?
9. List the points of contrast between alpha and gamma biodiversity.
10. Write the ecological significance of material cycles.
11. Explain afforestation.
12. Write the impacts of arsenic due to drinking water.
13. Draw carbon cycle.
14. Discuss "Hydrogen as a future source of energy".
15. How can you as an individual conserve different natural resource?
16. Define a biodiversity hotspot.

Long Answer Questions (5//7/9/10 Marks)

1. What do you understand by non-conventional energy resources? Discuss these in detail.
2. Describe renewable energy resource with two examples and diagram.
3. Explain in detail carbon and nitrogen cycle.
4. Describe carbon cycle in detail.
5. Draw and explain nitrogen cycle. Explain nitrification and de-nitrification process.
6. What is nitrogen cycle and Sulphur cycle? Justify the ecological significance.
7. Explain types of biodiversity. Explain different threats to biodiversity.
8. Briefly discuss the fluoride problem in drinking water.
9. What is Nalgonda process and where it has been used?
10. Explain water related diseases. Discuss in detail about water borne and water induced diseases.
11. What do you mean by water borne diseases? Discuss kinds of diseases their cause and effect on human being.
12. What is deforestation? Enumerate and discuss the various causes of deforestation.
13. Write the various factors which influence the deforestation and list the impacts of deforestation.
14. Explain the different methods of Biodiversity conservation.
15. Explain types of biodiversity. Explain different threats to biodiversity.