UNIT – II: NATURAL RESOURCES

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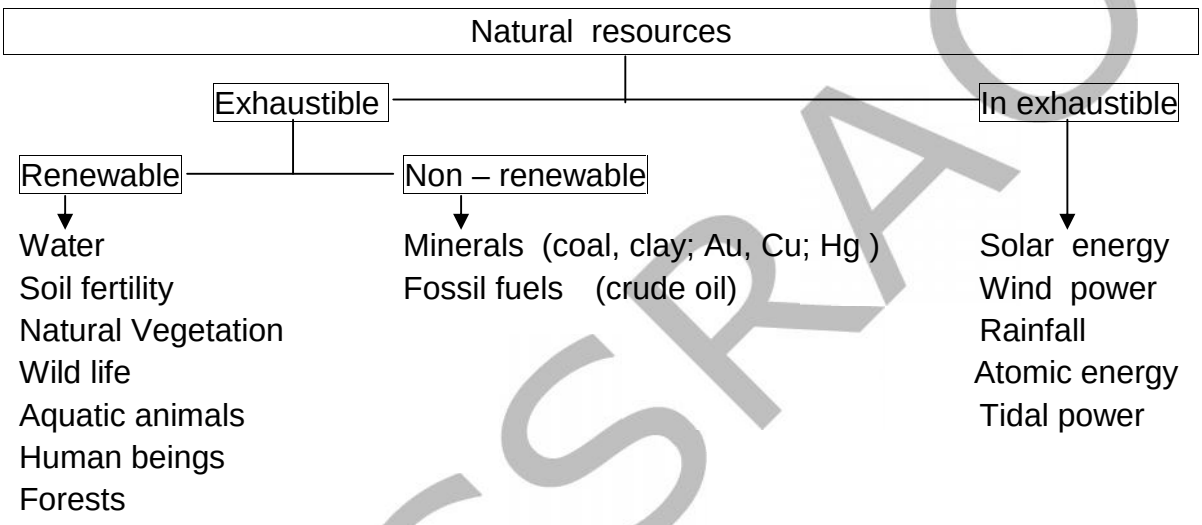
UNIT – II: NATURAL RESOURCES

The word resource means a source of supply. The natural resources include water, air, soil, minerals, coal, forests, crops and wildlife are examples. All the resources are classified based on quantity, quality, re-usability, men's activity and availability.

Classification of Resources:



Exhaustible Resources: These resources have limited supply on the earth and liable to be exhausted if used indiscriminately. These resources are of two types.

(1) ***Renewable resources***: These resources have the capacity to reappear themselves by quick recycling with a reasonable span of time. Eg: forests, wildlife.

(2) ***Non-renewable resources***: Resources that exist in a fixed quantity in earth's crust are called non–renewable resources. These resources lack the ability of recycling and replacement. Eg: minerals, fossil fuels etc..

A few mineral resources which occur in the earth's crust namely copper, aluminum, mercury, gold etc.., minerals of asbestos, clay and mica are considered as non-renewable resources.

Fossil fuels are derived from organic matter that accumulated during hundreds of millions of years of early bio-geological history. There is no way of recycling the energy in fossil fuels.

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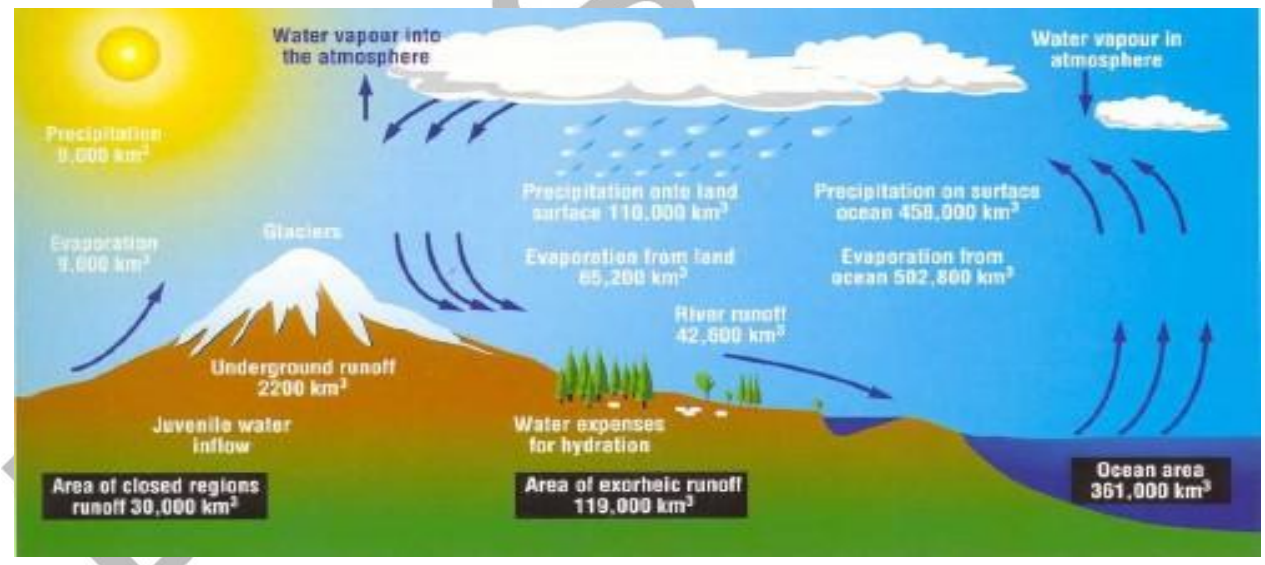
Inexhaustible Resources: These resources are present in unlimited quantity in the nature and they are not likely to be exhausted by human activities. Eg: solar energy, wind power, tidal power, rain fall, atomic energy etc…

It is very important to protect and conserve, the natural resources. Natural resources are to be used in a judicious manner so that they cannot be exhausted. It doesn't mean that we should stop using them. Natural resources are to be used in such a way that we can make use for future generations.

Among the natural resources, Water resources; Mineral resources; Energy resources; Land resources are the major ones to discuss

WATER RESOURCES

Hydrologic Cycle: The continuous circulation of water from land, water bodies etc., which joins the atmosphere and finally condenses into the form of precipitation. A part of water is lost by evapo-transpiration and certain portion percolates into the ground to form ground water reservoir and the remaining water flows on the ground as runoff and joins the streams, rivers and finally into sea. This cycle is continuously repeated.



Water is the main constituent of hydrosphere & is renewable resource. Water is next to air that man requires for his survival and existence.

Water is needed for daily use by organisms, for irrigation, industrial electricity production and domestic use. Hence, water is an important resource in all economic activities ranging from agriculture to industry. The distribution of water resources is not uniform over the earth's surface. About 97% of it is salt water in the seas & oceans, 2.6% is trapped in polar ice caps & glaciers. Only 0.4% is available as fresh water.

Fresh water occurs mainly in two forms as .

1. Ground water and 2. Surface water

The distribution of fresh water is geographically uneven varying greatly from country to country & even one region to another region.

Uses of water:

1. DOMESTIC USE: Water used in the houses for the purposes of drinking, bathing, washing clothes, cooking, sanitary & other needs. The recommended value according to Indian standard specification for domestic use is 135 liters/day

2. INDUSTRIAL USE: Water is required for various industries such as cement, mining, textile, leather industries.

3. PUBLIC USE: This includes water used for public utility purpose such as watering parks, flushing streets; jails etc.

4. FIRE USE: Water is used in case of accidents and to prevent the fire issues.

5. IRRIGATION: To grow crops which is the main sources for food.

6. OTHER USES: Hydro electric power generation requires water.

Effects of over use of ground water :

Over use of groundwater has following effects.

1. Lowering of water table: Excessive use of ground water for drinking, irrigation and domestic purposes has resulted in rapid depletion of ground water in various regions leading to lowering of water table & drying of wells.

The reasons for shortage of water are:

1. Increase in population,
2. Increasing demand of water for various purposes.
3. Unequal distribution of fresh water.
4. Increasing pollution of water sources cause over exploitation.

2. Ground subsidence: When ground water withdrawal is greater than its recharge rate, the sediments in the aquifer become compacted. This is called ground subsidence which may cause damage of buildings, destroy water supply systems etc.

Floods: A Large area of land with water for several days in continuation is called flood. Floods have been regular features of some parts of India & Bangladesh. Floods are caused by both natural as well as human factors. The (i) anthropogenic activities such as deforestation, construction activities, and diversion of river channels cause floods (ii) over-grazing also cause floods.

Floods are also caused by various factors such as, climatologically (due to rain), failure of dams (i.e., excessive release of water) and floods could get intensified because of basin characters. Flooding also takes place when the river channels are unable to contain the discharge.

Drought: The condition of dryness for prolonged period is called drought due to drop of average rainfall. Drought cause famine and starvation of human & animal population of region concerned. Drought is the most serious physical hazard to agriculture. Shortage of water for even the basic needs is the main problem in the drought areas. Shallow rooted plants don't grow. Infiltration wells, construction of dams, water sheds are being taken up in drought prone areas. Clouds seeding techniques, artificial rains etc., are to be implemented.

Conflicts over water: Conflict means a situation in which people, groups, countries are involved in a serious argument. Water is an essential resource for sustaining life and environment. The available water resources are under tremendous pressure due to increased demands. Conflicts over sharing of rive water between neighboring countries or different states of a country have now become quite common. The conflicts over water are continuing phenomena and leads to wars. Some examples of such conflicts in past & at present are listed below:

1. During Second World War many water dams were bombed.
2. Central dams over YALU River were attacked during Korean War.
3. Water supply systems in North Vietnam were bombed by US in1960's during Vietnam War.
4. The construction of Farakka Barrage across Ganga has become a dispute between India and Bangladesh. The Barrage is intended to divert water into river Hoogly to protect Calcutta port.
5. The Cauvery water dispute is between the states of Tamil Nadu and Karnataka. Tamil Nadu is occupying the downstream region of the river wants to use of upstream water whereas the upstream state Karnataka refused to do so.
6. The Sutlej –Yamuna link is the dispute between Punjab & Haryana.
7. The river basin of Fordan and the Nile are the shared water resources for Middle East Countries (Asia; Africa; Europe). Ethiopia controls 80% of Nile River water whereas Sudan (South Africa) too is trying to divert more water. The sufferer is Egypt.

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The following status have disputes :

Rivers	Disputing states
1. Yamuna	Delhi, Haryana, Rajasthan, Himachal Pradesh, Uttar Pradesh.
2. Narmada	Maharashtra, Gujarat, Rajasthan, Madhya Pradesh.
3. Krishna	Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka.
4. Godavari	Andhra Pradesh, Maharashtra, Orissa, Madhya Pradesh.
5. Cauvery	Tamil Nadu, Karnataka.

Dams benefits & problems : The construction of dams has their own benefits & drawbacks. Excess amount of water flowing in rivers which otherwise Join Sea can be stored as reservoirs by constructing the dams across the rivers. The dam's viz., Bhakra-Nangal, Heerakud, Nagarjuna sagar; srisailam etc generate electricity, to supply drinking water. Pandit Jawahar Lal Nehru called these dams as "THE TEMPLES OF MODERN INDIA".

USES:

1. More land can be brought under irrigation.
2. Hydro-Electric power can be generated.
3. Water can be supplied to towns & cities.

DISADVANTAGES:

1. Causes change in a climate of region at micro level.
2. Loss of vegetation & soil erosion.
3. Generation of seismic activities due to heavy pressure of water.
4. Blasting operations during construction of dams cause landslides.
5. Sedimentation & silting of reservoirs.

MINERAL RESOURCES

Minerals are naturally occuring inorganic, crystalline, solid having a definite chemical composition with a certain physical properties or a substance that is naturally present in the earth and is not formed from animal or vegetable matter.

In any country, the growth and development of industry depends on the availability and quality of deposits of minerals of economic importance. Mineral resources can be classified under three main types. They are metallic, non-metallic and atomic minerals.

Metallic minerals include native elements such as gold and silver ; haematite and magnetite (iron) ; Cuprite (copper) ; Laterite (aluminum) and non-metallic minerals include sand (quartz), garnet ; steatite (talc); muscovite (mica) whereas atomic minerals include Pitchblende (Uranium, Thorium).

The geological processes are caused for the formation of the minerals over million of years ago in the earth's crust. Minerals are generally localized in occurrence and the deposits are very sporadic in distribution. Mineral resources are non renewable and the mineral /ore is extracted by the process of mining. Much risk is involved in mining process because of high temperature, pressure variations, fire hazards and lack of ventilation in mines.

Minerals are used in a large number of ways for domestic, industrial, commercial sectors etc… Generation of energy by using coal (lignite / anthracite) ; uranium, gold, silver, platinum, diamond are used in jewellery. Copper, aluminum etc are used as cables for transmission of power.

Some of the minerals are used in ayurvedam as medicine.

Gold is reputed to strengthen the heart muscle and increase energy and stamina. By placing a piece of gold (devoid of stones) into 1000 ml of water and boiling it until reduced to 500 ml. Historical dose used gold ash of 10 mcg/day or gold water of 1 tsp 3x/day.

Silver is a very important healing substance due to its cooling and antiseptic properties. It is most useful for treating Vata and Pitta especially conditions involving weakness, and some of chronic fevers. It is also used for gastritis, inflammatory of the intestines. Historical dose used silver ash of 10-30 mcg/day or silver water of 1 tsp 3x/day.

Copper was used to treat conditions of excess kapha (primarily) and vata (secondarily). Historical dose used: copper ash: 10-30 mcg/day or copper water: 1 tsp 3x/day

Environmental effects: Mineral extraction and processing in mines involves a negative impact on environment. Mining process involves removal of over burden of soil, ore extraction & transportation, crushing & grinding of ore, water treatment of ore, storage of waste material

As a result of these activities cause air pollution, noise pollution, water pollution, loss of habitat of wildlife, concentration of toxic substances in tailing ponds and spreading of dust.

People working in mines often suffer from serious respiratory system and skin diseases. Mining often causes ground subsidence which results in tilting of buildings, cracks in houses, buckling of roads, bending of rail tracks etc.

Exploration process before a mining involves, geochemical, geophysical surveys drilling activities which causes for air pollution, noise pollution etc.. In addition, disturbance of all vegetation (flora) and fauna (animals) from that a region.

Remedial measures: Atmospheric pollution due to mining and associated activities can be minimized by planning and using dust extractors, by optimizing the blast design, maintenance of roads and sprinkling of water for easy movement of dumpers, by using eco generators (sound proof), proper maintenance of equipment and the machines not only minimize the air pollution but also the noise generation.

case studies of mineral resources

1)Aravalli hills in Rajasthan: The Aravallis hills spread across Haryana, Rajasthan and Gujarat and control the climate and drainage system of the region. Mining activity is being taken in this region due to immense mineral wealth (Talc, marble, granite).

Rajasthan state alone has 9700 industrial units connected with mining and 90% of forest has been depleted over the past 20 years. When the mining activity reached below the under ground water level, a cone of depression was formed in the surrounding areas and ultimately bore wells, dug wells, dried up and affected agriculture in a massive level.

Several studies have pointed out that the natural drainage system and the ground water table of the entire region have been badly affected. Pollution levels have also increased. Lung diseases, silicosis were attacked by the laborers.

In November 2002, the Supreme Court imposed a blanket ban on mining activities in the Aravalli hills. The court ruling closed all 9700 units. The environmentalists have alleged that mining has affected the water, forest and the land.

2)Uranium mining in Nalgonda: The Uranium Corporation of India proposed to mine Uranium from the deposits of Lambapur and Peddagattu villages of Nalgonda dist. Processing unit was proposed at Mallapur village in Nalgonda dist by offering employment opportunities. But experts didn't propose mining activity because of possible contamination of water.

The proposed mines are just 1 km away from human habitation and 10 km from Nagarjuna sagar dam and 4 km away from Akkampalli reservoir, which is a source for drinking water.

3**) Gold mining in Europe**: Potassium Cyanide is used during the process of gold treatment. In 2000, the ***Baia Mare Gold mine*** in Romania (Europe), released 80 million litres of less concentrated cyanide into the Tisza river. The cyanide flowed 500 km via Hungary and Serbia cities caused for diseases.

4**) A *Gold and Copper project of Tedi Island in New Guinea*** released 1000 cubic meters of less concentrated cyanide into a river and affected the culture and lifestyle of Guinea people.

LAND RESOURCES

Land is the major part of the lithosphere. Land is made up of soils / rocks and are considered as very important resources of earth. Land plays a major role for growth of crops, vegetation, forests etc., Soils are formed due to disintegration of rocks by various physical processes like change in temperature, pressure, blowing wind and flow of water.

The top layer of soil consists of mixtures of Humus (dead leaves & plants), some of the living organisms and Inorganic components which supply nutrients to the soil.

Soil fertility depends on inorganic matter, organic matter, water, air and a variety of micro-organisms viz., bacteria, fungi, which help in the decomposition of organic matter and regeneration of nutrients.

Distribution of land resources

The utilization of land distribution in India as under:

Agriculture land	43.60 %
Pastures	14.60 %
Waste lands but cultivable	12.20 %
Forests	10.70 %
Barren land	8.40 %
Urban land	5.30 %
Unavailable information on lands	5.20 %
Total	100.00 %

Types of Indian Soils

Different types of soils are identified by taking into account the geographical extent, physical and chemical properties for the purpose of agriculture, nutritional factors.

(a) ***Alluvial soils***: This is generally alkaline and best soil for agriculture. Alluvial soils are derived from debris brought by the floods or rivers or by tidal waves. Eg: North Indian Plains; Indo–Gangetic Plain; Ganga and Brahmaputra Plains …

(b) ***Black soils***: Black soils are predominantly with clay and sandy loams. These soils are found in the regions of AP (Krishna and Tungabhadra basins) , Maharashtra (Deccan Traps) and Madhya Pradesh.

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(c) ***Red soils***: The red colour is due to the presence of high proportion of iron component and characterized by low water retention capacity. Red soils are found in Andhra Pradesh, Tamil Nadu and parts of Bihar, Orissa and Western Ghats of Karnataka..

(d) ***Laterite soils***: These soils are rich in hydroxides of Ferrous and aluminum. At low elevation areas, the laterite soils are suitable for paddy cultivation whereas at higher elevations, they are suitable for coffee, tea, rubber etc., Western Ghats, Northern part of Eastern Ghats, North of Bangalore and West of Hyderabad are examples for laterite soils.

(e) ***Mountain soils***: These are stony. Mountain soils are formed due to dislodgement of rocks due to land slides and occur over altitudes between 2000 to 3000 mts. Eg: Aravallis and East of Himalayas. Mountain soils are favour for growth of vegetation / forest .

(f) ***Desert soils***: These soils cover the parts of areas of Rajasthan and Kutch where the annual rainfall is less than 50 cms per annum.

(g) ***Saline soils***: Presence of salt and water retention make the soils unsuitable for agriculture. Eg: Arid (no rain) and Semi arid (partly rain) regions of northern plains and Maharashtra.

Soil erosion and causes for soil erosion

The top layer of the earth is called as soil. Soil erosion occurs due to deforestation, overgrazing, industrialization; desertification etc.

Deforestation: Mining, industrial, urban development etc causes deforestation and leads to exposure of the land to wind and rains causing soil erosion. Cutting trees leads to deforestation which in turn loss of organic matter in the soils.

Overgrazing: When sufficient amount of grass is available for the organisms usually the entire land /area may be subjected to exhaust and the land is exposed without grass and ultimately the land expose to wind/rain causing soil erosion. .

Industrialization: Different processes carried out by industries and mining operations cause soil pollution which leads to degradation of land.

Desertification: The process of conversion of productive lands to unproductive lands is called desertification. This occurs due to loss of top layer of soil by erosion. Erosion of top layer results in loss of water holding capacity and finally converted in to unproductive areas .

Land degradation and control of land degradation

Land degradation can be defined as any change in the land that alter its conditions or reduces its quality. Land degradation occurs due to both natural disasters like volcanic eruptions, earthquakes, heavy rains, fire etc or human induced activities. The other causes of land degradation consists of wind blow, salinity of water, water logging, soil acidity, loss of flora and fauna.

Desertification is land degradation occurring in the arid, semi-arid regions of the world. These dry lands cover about 40% of the earth's surface and puts at risk more than 1 billion people who are dependent on these lands for survival.

Land clearing and deforestation; Mining activity in forest areas; urban conversion; bringing more land under cultivation; soil pollution ; loss of organic matter in the soils; alkalinization of soils; salinity of water etc leads to land degradation.

Severe land degradation affects in decreasing the mineral wealth and economic development of nations.

The methods that are followed for the prevention of land degradation are called soil conservation methods. Some of the popular methods are;

(a) ***Contour farming***: The land is prepared with alternate furrows (a long narrow cut in the ground) and ridges at the same level . The water is caught and held in furrows and stores which reduces run off and erosion.

(b) ***Mulching***: Stems of maize, cotton, tobacco etc are used as a mulch (decay of leaves) to reduce soil moisture, evaporation .

(c) ***Crop rotation***: Growing same crop year after year depletes the nutrients and land becomes unproductive. This is overcome by changing the crops and cultivating legumes (plants like peas, beans) after a regular crop.

(d) ***Strip cropping***: It consists of planting crops in rows or strips along contours to check flow of water.

(e) ***Agrostological methods***: Korean grass, Mexican grass are grown as erosion – resisting plants.

(f) ***Miscellaneous methods***: Construction of bunds, drains, widening of gullies, Afforestation methods prevent the soil erosion.

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Landslides and man induced land slides

Landslides are always exist on this planet and the term land slide is used to describe a wide variety of process that result a downward movement of rocks under gravitational forces. In other words, mass movement of rocks, debris and soil down a slope of land.

Landslides are primarily associated with steep slopes . Surface run-off and changes in drainage also cause for landslides. Landslides can also be initiated by rainfall; earthquakes; volcanic activity, changes in groundwater movement or any combination these factors.

Debris-flows can travel down a hillside of speeds upto 200 miles per hour (more commonly, 30 – 50 miles per hour) depending on the slope angle, water content, and type of earth and debris in the flow.

While landslides are a naturally occurring environmental hazard they have recently increased in frequency in certain areas due to human activities. Building excavations, collapses in mining (eg : coal mine) causes landslides.

However, landslides can be triggered by the human beings by induced changes in the environment.

Simply landslides can be explained in three ways:

(a) Inherent of rocks (weakness in the structure of a rock)
(b) due to heavy seismic or volcanic activity and
(c) due to various environmental conditions.

ENERGY RESOURCES

The term energy means capacity to do work . Energy can neither be created nor destroyed but transformed from one form to other . Energy is closely related to force. When a force causes an object to move, energy is being transferred from the force to kinetic energy.

Energy is present in a number of forms such as mechanical, thermal, chemical, biological energy etc.. Energy production and utilization have become essential to carry out many activities in modern life. Energy is one of the important requirements that a country needs for its economic growth. At the same time, energy production has its impact on environment due to pollution and finally affects the quality of life of people. The energy is used for the following purposes:

a) Cooking, heating and lighting
b) Transporting people and goods by means of vehicles.
c) Manufacturing consumer goods and equipment
d) conversion of fuels into other forms of energy for various use.. For eg:
   (1) burning coal to produce electrical energy or mechanical energy
   (2) Chemical to electrical by dry cell batteries
   (3) Using water in dams to produce electricity through mechanical energy.

The power generation capacity in the country has increased from 1400 MW at the end of 1947 to 92,894 MW at the end of 1999 from various sectors comprising as under:

Hydro sector	22,438 MW
Thermal sector	67,618 MW
Nuclear sector	1,870 MW
Wind sector	968 MW
From all sectors	92,894 MW

There are two types of energy sources namely:

(1) Renewable energy sources and (2) Non – renewable energy sources.
The important renewable energy resources are described below:

Solar energy: The energy which is derived from the sun is known as solar energy. It can be used for direct heating or sun's heat is converted into electricity. Photo voltaic cells convert direct solar energy into electricity.

A number of solar equipments have been developed to utilize sun rays to heat water, to cook food, to pump water and to run certain machines and used for street lighting, railway signals etc. But the major problem with solar energy is that during cloudy weather it is available in less quantities than on sunny days.

Hydro-Power energy: Electrical power is generated by hydro-electric projects in which dams are constructed across the river. The kinetic energy of water is converted into mechanical energy by means of turbines and in turn, the mechanical energy is transferred into electrical energy by generators. Hydro power projects lead to several environmental problems like destruction of animal habitats, deforestation , migration of people etc..

Geothermal energy: Geothermal energy found within rock formations. Inside the earth the temperature rises with depth .The temperature in earth's crust is around 4000^{o} C. Geysers (a natural spring that emits hot water) and hot springs are examples for geothermal energy where the steam and hot water come to the surface, in areas where the steam is tapped by drilling. The obtained steam is then used to generate power.

Air pollution results in case of geothermal energy where the gases like H_2S, NH_3, CO_2 present in the steam coming out of the geothermal sources. The overall efficiency for power production is low (15%) as compared to fossil fuels (40%).

Wind energy: Wind energy is the kinetic energy associated with the movement of atmospheric air. Wind mills convert the wind energy into electrical energy. On an average wind mills can convert 30 – 40 % of available wind energy into electrical energy at a steady wind speed of 8.5 mts / sec. The efficiency of wind mill is increased with the speed of wind and length of rotor blade.

The total wind energy potential in India's estimate is 25,000 MW of this about 6000 MW is located in Tamil Nadu; 5000 MW in Gujarat and contribute the states of Andhra Pradesh, Maharashtra, Uttar Pradesh and Rajasthan for balance quantity.

Merits & demerits of wind energy:

1. It is a non – polluting and environment friendly source of energy.
2. It is a renewable energy available at free of cost
3. Power generation is cheaper with nil recurring expenses.
4. Wind mills are suitable to erect at on shore, remote and rural areas where wind blows with required intensity.
5. Favorable in geographic locations which are away from cities.
6. Wind turbine design, manufacturing, installation is complex due to varying atmospheric conditions.
7. Wind power doesn't suitable for large scale generation.

Ocean energy: Seas and oceans are large water bodies . Seas absorbs solar radiation and large amounts of solar energy is stored in the tides and waves of the ocean. Ocean energy is non – polluting in nature and suitable at a few places only. Energy from seas or oceans is obtained from the following:

(1) *Ocean Thermal Energy Conversion*: The oceans collect and store huge quantities of solar on the surface of the water while the temperature of deep waters is very low. Using this temperature difference it is possible to convert heat into electricity.

(2) *Tidal energy*: Tidal waves of the sea can be used to turn turbine and generate electricity. Asia's first tidal power plant of 800 - 1000 MW capacity is proposed to be set up at Kandla in Gulf of Kutch.

(3) *Wave energy*: The wind blowing over water generates waves. A unique property of ocean waves is their ability to travel vast oceanic distances with negligible loss of energy and ultimately arrives the continental margin of that basin.

India's first wave energy power plant of 150 KW capacity has been commissioned in Thiruvananthapuram, Tamil Nadu. 1 MW wave energy plant is being set up in Andaman and Nicobar islands.

(4) *Current energy*: Theoretically, the ocean water used to generate energy by allowing the water to pass through a series of turbines installed under water. The turbines are to be sealed and are kept at a depth of 10 to 20 mts. A propeller with a dia of 5 mts can generate about 150 MW of power.

Bio mass energy: Bio-mass is an organic material from living beings or its residues. It is a renewable source of energy derived from the waste of various human and natural activities. The bio-mass energy sources include Wood, animal manure, sugarcane waste, agriculture crops, house hold waste, roots of plants, garbage etc. The simplest way of using bio-mass energy sources is to allow them to dry out in the sun and burn them.

Bio-gas: Bio-gas is a sustainable source of energy by virtue of its production from available natural organic wastes of cattle dung, human excreta, poultry waste, plant leaves, paddy husk etc…. Bio-gas is a mixture of methane (68%), CO_2 (31%) and N_2 (1%). Methane gas (CH_4) is produced by bio-gas plants and this gas is utilized as cooking gas whose calorific value varies from 4400 – 6200 Kilo Calories / cum. Heat value of bio gas can be improved by reducing its CO_2 content.

Bio-gas production is carried out in an enclosed bio-gas plant made of bricks or steel. A slurry of waste organic matter is fed into the plant through an inlet and gas formed is tapped by an inverted drum. As gas is produced the drum rises and the gas may be drawn through an outlet.

Bio-gas is commonly produced from cattle dung in a bio gas plant known as Gobar Gas plant. Bio-gas is a clean, cheap fuel that can be used for lighting purpose, lifting water through small pumps.

Non – renewable energy resources include (a) fossil fuels such as coal, crude oil , natural gas and (B) nuclear energy.

Fossil fuels: Fossil means the remains of an animal or a plant which have become hard and turned into rock. All these found in earth's crust which have been formed in the past by the geological processes. Fossil fuels are solid coal (lignite), liquid (crude oil / petroleum) and gases (natural gas).

Coal ***:*** Huge quantity of plant materials buried under earths crust and altered by geological process and converted into carbon rich fuel. It is a non – renewable source because it takes a very long period (million of years) for its formation.

Coal is extracted by the process of mining and involves accidents due to mine collapse, ground water pollution, accumulation of poisonous material, explosive gases etc cause diseases. CO_2 pollution leads to green house effect (global warming).

Crude oil: It is obtained in the form of liquid . The crude oil is heated upto 600^o C in the oil refinery and condense the vapours of hydro – carbons. Petrol and other petroleum products are refined fuels from crude oil.

Petroleum products are used in large quantities in the manufacture of detergents, plastics, fertilizers, pharmaceuticals, synthetic rubber etc.. The transport sector consumes about 40% of diesel; 25% industries and 19% household and rest 16% agriculture and other sectors. .

Natural Gas: Gas deposits are trapped from the sedimentary formations by means drilling holes into the rock formations. While burning of natural gas, the emission of CO_2 is less and thus reduces green house effect and global warming. A total of 734 billion cubic mts of gas is estimated as proven reserves.

Nuclear Energy or Atomic power: It is the energy which is trapped inside the atom. It is non–renewable source of energy which is released during fission or fusion of certain radio active elements. The most important advantage of atomic power is the production of an enormous amount of energy from a small quantity of radio active element. For eg: 1 kg of Uranium liberates energy equivalent to 30000 kgs of coal.

Energy released during nuclear reaction (mass – energy equation as per Albert Einstein's formula $E = mc^2$). Nuclear Energy is produced by two processes namely (1) Nuclear Fission and (2) Nuclear Fusion.

Nuclear Fission: The nucleus in atoms is split by fast moving neutrons and in turn a tremendous amount of energy in the form of heat, light etc is released by a chain of reactions. Uranium is used as fuel. The energy released slowly in this process is utilized to generate electricity or else released suddenly all at once, results a tremendous explosion as in the case of Atom bomb.

Nuclear Fusion: Nuclear energy can be generated by fusion process which involves two hydrogen atoms combine to produce one helium atom. Eg: hydrogen bomb. The disposal of nuclear wastes during mining, fuel production and reactor operation for a long time period resulting in adverse effects on environment. Disposable of nuclear waste is a national and global problem.

FOOD RESOURCES

The main sources of human food are plants and animals. Human beings consume almost all parts of plants in the form of ***cereals*** (wheat, barley, millet, rye, oats, maize, corn, rice etc.); ***pulses*** (peas, red grams, green grams); ***vegetables*** (carrot, cauliflower, beans); ***fruits*** (banana, orange, grapes, pineapple) and ***spices*** (pepper, cloves). Also a number of products such as milk, butter, egg and meat supplement the requirements.

To carry out the physiological metabolism of human system successfully, a continuous supply of energy in the form of food is required. Usually food comes from three sources. ***Agriculture activity*** is the major source for food production which provide 76% of the total, mostly as good grains. ***Meat*** from grazing livestock (cows, sheep eat grass that is growing in a field), accounting for 17% and ***fisheries*** that supply the remaining 7%.

Enough food in the world is available to provide atleast 2 kg per person a day including grains, beans, nuts, fruits, vegetables, meat, milk and eggs but the problem is that many people are too poor to buy readily available food. Atleast 700 million people do not have enough to eat. Every year hunger kills 12 million children world wide. India now produces 180 – 210 MT of food grains, 5 MT of meat products and 6 MT of fish annually.

Since world's population is growing every year and the demand of food is also increasing continuously. Although world's food production has increased almost three times during the last 50 years, but at the same time rapid population growth outstripped the food production. So, the world food problem is a complex one depending on food production, population increase, the prevalence of poverty and environmental impacts.

Famines are due to lack of access to food but not lack of food. Modern agriculture is largely based upon technological factors like the use of improved seeds, chemical fertilizers, synthetic pesticides etc…

The **green revolution**, however changed traditional agricultural practices with a rapid increase in food production in developing countries. An American agricultural scientist, **Norman Borlaug** developed a high yielding variety of wheat through new concepts in plant breeding. By the mid 1960's , the green revolution was fully adopted in India.

There are two types of agricultural systems:

(1) Traditional system and (2) Modern and Industrialized system

The traditional system is again subdivided into two types namely:

(a) ***Traditional Subsistence Agriculture*** *(TSA*): In this system, only enough crops or livestock are produced for the use of family and a little surplus to sell to meet the needs.

(b) ***Traditional Intensive Agriculture*** *(TIA):* Farmers increase their inputs of human labour, water fertilizers to get higher yields for the use of their families and to sell a small quantities for getting income.

In the system of ***modern and industrialized agriculture***, a large extent of land will be brought under agriculture and huge quantities of fuel, energy, water, chemical fertilizers, pesticides used to produce large quantities of single crops purely for sale. This system is spreading in India in the name of Green revolution. But this modern agricultural system has its own adverse effects on environment.

- Excessive use of chemical fertilizers to boost up the crop yield, contaminate groundwater with nitrate. The presence of excess of nitrate in drinking water is dangerous for human health. Excess Nitrate reacts with haemoglobin and causes for " ***Blue Baby Syndrome***" which kill the infants.
- The excessive N P K fertilizers in agriculture fields are often washed off with water and leads to ***algal blooming*** and ***Eutrophication. Phosphates*** have been accumulating in soils, lake sediments for decades change the ecology. Increased levels of phosphates in water bodies cause Eutrophication (growth of unwanted plants).

- The excessive use of pesticides enter the food chain and become hazardous to human life.

- A large area of fertile land have become saline in recent years due to excessive irrigation.

- Consumption of fuel energy is more when shifting of human and animal labour to agriculture machinery. Use of fuel leads to air pollution.

- Continuing to increase input of fertilizers, water and pesticides eventually produces no additional increase in crop yield but slows down the productivity of the crop.

- Due to increased irrigation, the underground ***aquifers are slowly and constantly becomes dry***. The rate at which they are being depleted is much faster than its recharge.

- Excessive application of chemical fertilizers can increase soil ***salt content***. The percolation of domestic and industrial sewage also increase the salinity of soil.

- The stagnation of water in the soil in the upper layers causes for ***water logging*** which causes for less oxygen availability for respiration of plants.

Fertilizers are defined as materials having definite chemical composition that supply nutrients to plants. Most of the chemical fertilizers are inorganic in nature. Plants need water, sunshine, CO2 and nutrients for their successful growth and production.

The nutrients are of two types. (a) ***Macro Nutrients*** (N, P, K) and (b) ***Micro Nutrients*** (Ca, Mg, S, Fe, Zn, Ba). Farmers are tempted to use fertilizers in excessive quantities to get more yield by ignoring the presence of nutrients in the soil naturally. The excessive fertilizers percolates along with water into the soil and pollute the ground water.

Nitrate contaminate the water and leads to health problem to the animals and people who use such water. Nitrates in excess over 50 mg / litre in ground water causes “Blue Baby disease “.

Phosphates have been accumulating in soils, lake sediments for decades change the ecology. Increased levels of phosphates in water bodies cause Eutrophication (growth of unwanted plants).

The alternate methods to prevent chemical fertilizer problems are the use of organic manure, crop residues, green manure, crop rotation, high yield crop varieties.

Pesticides are used in order to prevent the damage caused by several types of insects, weeds and micro-organisms. Pesticides are of 3 types. (a) ***Insecticides*** (insect killers) (b) ***Nematocides*** (worm killers) and (c) ***Rodenticides*** (rat and mouse killers). World wide about 2.3 million MT of pesticides are used yearly.

Some of the examples of pesticides are DDT, Aldrin dieldrin, Toxaphene, Lindane, Chlorodane, Methoxychlor, Malathian, Pyrethrum, Aldicarb, Carbaryl, Rotenone, atrazine etc..

Entire agriculture suffers from Pests. Pests are undesirable parasites or predators. The major agriculture pests are insects that feed on leaves and stems of plants. Eg: Nematodes are small worms that feed on roots.

Pesticides are applied in the form of dry powders, solutions, emulsifiable concentrates. Soil micro organisms (earthworms); pollinating insects (butterflies); Natural predators (birds) that consume the poisoned dead pets are killed by the pesticides causing considerable environmental damage. Short term effect include illness caused by pesticide food grains, fruits etc whereas long term include cancer, immunological, chronic diseases

Case studies:

(1) Salinity in Haryana and Punjab: Thousands of hectares of land area in Haryana and Punjab are affected by soil salinity and alkalinity.
(2) Water logging in Punjab, Haryana, Rajasthan: About 1.2 million hectares of land in Haryana resulted in rise in water table followed by water logging and salinity due to canal irrigation.
(3) The soil water containing salts seep into the pipes slowly and is drained out of the fields. The Central soil Salinity Research Institute (CSSRI) in Karnal dist of Haryana converted the barren lands into productive lands.

FOREST RESOURCES

Forests are one of the most important natural resources on this earth predominantly composed of trees, shrubs, woody vegetation etc… Approximately 1/3rd of the earth's total land area is covered by forests.

Functions of forests: Forests have three types of functions

1. **Productive functions:** This includes the production of timber, bamboos & a variety of compounds such as resins, alkaloids (poisonous substance in plants), oil and pharmaceuticals.

2. **Protective functions:** It includes conservation of soil and water, prevention of drought, protection against wind, cold, radiation, noise, odours etc…

3. **Regulative functions:** This includes absorption, storage and release of gases like CO_2 & O_2. Droughts & particularly CO_2 is regulated by forests. The regulative functions of forests improve atmospheric & temperature conditions.

Types of forests: Forests are important ecologically and economically. Forests are the important renewable resources which contribute sustainability to the economic development of a country.

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1. **Savannas:** These forests develop where a seasonal rainfall occurs. The grass lands of North Africa are known as savannas. Eg: North Africa, America, Burma & India.

2. Tropical forests: These exits in areas of good rainfall (>200cm per year) with uniform warm temperature. The Soils found in there forests are old, acidic in nature & poor in nutrients. Eg: Amazon rain forest (South America, India).

3. Deciduous forests (or) Temperate forests: Deciduous forests also known as temperate forests with a broad leaved trees & occur where rainfall is plenty (750 - 1000 cms per year). Destruction of these forests results in soil erosion & loss of biodiversity in the eco system. Eg: Europe & North-East America.

4. **Coniferous forest:** These occur in areas with long winters with heavy snowfall. In other words, where moisture is limited & rainfall is low. Herbivores (animals eating plants) & insects exist in these forests. Eg: Moscow.

Uses of Forests: The uses of forests can be broadly classified as follows
(a) Commercial uses and (b) Ecological uses.

a. Commercial Uses:

i. Forests provide a large number of commercial goods which include timber, firewood, pulp wood, food items, gums, resins, non-edible oils, rubber, bamboos, medicines etc…
ii. Half of the timber cut each year is used as fuel for cooking.
iii. $1/3^{rd}$ of the wood harvest is used for building materials as plywood, hardwood etc...
iv. $1/6^{th}$ of the wood harvest is converted into pulp & used for paper industry.

b. Ecological uses:

i. **Production of O_2**: Trees produce O_2 by photosynthesis.
ii. **Reducing global warming**: CO_2 is absorbed by the forest as a raw material for photosynthesis. These forests reduce the problem of global warming caused by green house effect.
iii. **Wild life habitat**: Forests are the homes for millions of wild animals & plants. About 7 million species are found in the forests alone.
iv. **Soil conservation**: Forests bind the soil particles tightly in their roots & prevent soil erosion.

v. **Pollution moderators**: Forests can absorb many toxic gases & help in keeping the air pure & fresh. In addition to the above, forests protect people from drought & floods; protect from radiation etc…

Over exploitation of forests: Forests come under renewable resources which are replenished through natural cycles. The highest rate at which the forest resources can be used indefinitely without reducing their available supply is called sustainable yield. If the utilization rate exceeds the natural replacement rate, the available supply begins to shrink and leads to rapid environmental degradation.

Reasons for over exploitation:

1. For instant profit without realizing the longer term.
2. When the forest resources are over exploited the supply of wood & other products diminish & ultimately the price of wood & other products increases. This leads to further over exploitation of forests.
3. To meet basic needs, people are forced to over exploit the forest resources.
4. Ignorance & lake of awareness also causes for over exploitation.

Deforestation and causes of Deforestation

Deforestation is defined as the removal of trees in the forests. The removal of trees leads to adverse effects as it leaves soil exposed & results in soil erosion, rapid water run-off, loss of wildlife. Forest ecosystems are extremely good & hold a good quantity of water. About 80% of the original forests on the earth has already been cleared. Only 20% of forest area (63 million hectares) is seen based on satellite date as per National Forest Policy.

Disadvantages of deforestation:

1. A variety of food products such as coffee, tea, spices, nuts, fruits etc will be reduced.
2. Various living beings may come down resulting in imbalance of forest ecosystem.
3. Soil erosion increases to a great extent.
4. Rainfall decreases to a great extent.
5. Climatic conditions are changed.
6. Wildlife is diminished.
7. Historical values are lost.

case studies

1. **Sardar Sarovar dam:** The dam is situated on river Narmada & is spread over three states of Gujarat, Maharashtra & Madhya Pradesh. The aim of the project was to provide irrigation water, drinking water & electricity for 3 states. A total of 1,44,731 hectares (or) 3,57,638 acres of land was submerged by the dam. A total of 573 villages were submerged. Submerged area was rich in wildlife. Eg: Tigers, Panthers, Bears, Wolves, Hyenas, Jackals, Crocodiles, Turtles etc.

Thus the massive loss of wildlife species was apprehended. Displacing of 80,000 tribal people of oldest civilization. Hence the project management & Govt. to pay maximum attention for proper rehabilitation.

2. Tribal people:

a. The lives of millions of tribal peoples of the world (5% world population) are the worst affected due to deforestation.
b. They get their food by hunting, gathering, trapping animals.
c. Many tribal's of Kaunas of PANAMA, Kenya's in Indonesia, Yanomami in Brazil were dispersed by leaving their places due to deforestation & construction of dams.

3. Dams & their effects on forests and people: Construction of large dams in forests & in sensitive areas cause ecological problems & destruction of ecosystem in the long run. The construction of large dams and reservoirs have their own benefits and drawbacks. Excess amount of water flowing in rivers, which, otherwise joins the sea, can be stored in reservoirs formed by constructing dams across the rivers. The stored water can be utilized for various purposes like water supply, irrigation, hydroelectric power generation at the desired rate.

a. Tehri dam on river Bhagirathi in Uttaranchal state.
b. Bhakra dam on river satlej in H.P.
c. Silent valley hydro electric project in Western Ghats.
d. The crusade against the ecological damage & deforestation caused due to Tehri dam was led by sri Sunderlal Bahuguna, the leader of Chipko movement.
e. Disappearing tea gardens in chhota Nagpur: Chhota Nagpur is a place favouring tea plantation, which is located in hilly region. Following destruction of forests, rainfall declined in Chhota Nagpur causing that the tea gardens were also disappeared from region.

Anthropogenic	Related to human activities
Over-grazing	Damaged by many animals feeding on it
Intensified	More serious
starvation	To suffer due to lack of food