

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources: Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

NATURAL RESOURCES

- Resources does not refer to a thing or a substance but to a function which a thing or substance may perform or to an operation in which it may take part namely the function or operation of attaining a given end such as satisfying a want.
- Resource, therefore, means to attain given ends. The aspect of satisfaction is so important that we consider a thing or substance resource so long it meets our needs.
- Life on this planet depends upon a large number of things and services provided by the nature, which are known as Natural Resources. Thus water, air, soil, minerals, coal, forests, crops and wild life are all examples of natural resources.
- Any material which is required or used to sustain life or livelihood is termed as are source.
- In other words, resources are all these requirements of organisms, population and communities which tend to help in accumulation of energy by their increased availability.
- Some examples of resources are air for breathing, water for drinking, land for living and growing food, forests for timber and paper, ores for aluminium, copper, iron and other metals and coal, oil and natural gas for producing energy.

Natural Resources

- A natural resource is defined as a form of energy and/or matter which is essential for the functioning of organisms, populations and ecosystems.
- In the case of humans, a natural resource, in his words, refers to any form of energy or matter essential for the fulfillment of physiological, socio-economic and cultural needs, both at the individual level and that of the community. Life on our planet earth depends upon a large number of things and services provided by the nature, which are known as natural resources. Water, air, soil, minerals, coal, forests, crops and wild life are all the examples of natural resources.
- According to Ramade (1984), a natural resource is defined as a form of energy and/or matter, which is essential for the functioning of organisms, populations and ecosystems.

Classification of natural resources:

- According to Odum (1971), natural resources can be divided into two categories such as
 - renewable
 - Non renewable resources

Renewable resources

- The resources that can be replenished through rapid natural cycles are known as renewable resource.
- These resources are able to increase their abundance through reproduction and utilization of simple substances. Examples of renewable resources are plants, (crops and forests), and animals who are being replaced from time to time because they have the power of reproducing and maintain life cycles.
- Some examples of renewable resources though they do not have life cycle but can be recycled are wood and wood-products, pulp products, natural rubber, fibers (e.g. cotton, jute, animal wool, silk and synthetic fibers) and leather.
- In addition to these resources, water and soil are also classified as renewable resources.
- Solar energy although having a finite life, as a special case, is considered as a renewable resource in as much as solar stocks are inexhaustible on the human scale.

Non-Renewable Resources

- The resources that cannot be replenished through natural processes are known as non-renewable resources.
- These are available in limited amounts, which cannot be increased. These resources include fossil fuels (petrol, coal etc.), metals (iron, copper, gold, silver, lead, zinc etc.), minerals and salts (carbonates, phosphates, nitrates etc.).
- Once a non-renewable resource is consumed, it is gone forever. Then we have to find a substitute for it or do without it.

Non-renewable resources can further be divided into two categories

- re-cycleable
 - These are non-renewable resources, which can be collected after they are used and can be recycled. These are mainly the non-energy mineral resources, which occur in the earth's crust (e.g. ores of aluminium, copper, mercury etc.) and deposits of fertilizer nutrients (e.g. phosphate rock and potassium and minerals used in their natural state (asbestos, clay, mica etc.)
- non-re cycleable
 - These are non-renewable resources, which cannot be recycled in any way. Examples of these are fossil fuels and uranium, which provide 90 per cent of our energy requirements

Some authors prefer to classify resources into biotic and abiotic resources

- Biotic resources
 - These are living resources (e.g. forest, agriculture, fish and wild life) that are able to reproduce or replace them and to increase
- Abiotic resources
 - These are non-living resources (e.g. petrol, land, minerals etc.) that are not able to replace themselves or do so at such a slow rate that they are not useful to consider them in terms of the human life times.

Natural resources can be classified as

- Inexhaustible
 - The resources which are not changed or exhausted by man's activities and are abundantly available for ever are said to be inexhaustible. Examples are solar energy, atomic energy, wind power, power from tides etc. Most of the renewable resources are classified as inexhaustible. But if not maintained properly, they become extinct. For example, ground water is renewable only if water continues to percolate in the soil at a rate at which it is removed
- exhaustible resources
 - These resources are limited in nature and they are non-maintainable e.g. coal, petrol and some minerals etc. Hence, they come under non-renewable category.
 - Even our renewable resources can become non-renewable if we exploit them to such extent that their rate of consumption exceeds their rate of regeneration. For example if a species is exploited so much that its population size declines below the threshold level then it is not able to sustain itself and gradually the species becomes endangered or extinct.
 - It is very important to protect and conserve our natural resources and use them in a judicious manner so that we don't exhaust them. It does not mean that we should stop using most of the natural resources. Rather, we should use the resources in such a way that we always save enough of them for our future generations

Following are some examples of the major natural resources:

- Forest resources
- Water resources
- Mineral resources
- Food resources
- Energy resources
- Land resources

FOREST RESOURCES

- It is a dense growth of trees, together with other plants, covering a large area of land.
- Forests are one of the most natural resources on this earth. Covering the earth like a green blanket these forests not only produce innumerable material goods, but also provide several environmental services which are essential for life.
- About 1/3rd of the world's land area is forested which includes closed as well as open forests.
- Former USSR accounts for about a 5th of the world's forests, Brazil for about a 7th and Canada and USA each for 6-7%.
- But it is a matter of concern that almost everywhere the cover of the natural forests has declined over the years.
- The greatest loss occurred in tropical Asia where one third of the forests resources have been destroyed

USES OF FORESTS: Commercial Uses

- Forests provide us a large number of commercial goods which include timber, firewood, pulpwood, food items, gum, resins, non-edible oils, rubber, fibers, lac, bamboo canes, fodder, medicine, drugs and many more items, the total of which is estimated to be more than \$ 300 billion per year.
- Half of the timber cut each year is used as fuel for heating and cooking.
- One third of the wood harvest is used for building materials as lumber, plywood and hardwood, particle board and chipboard.
- One sixth of the wood harvest is converted into pulp and used for paper industry.
- Many forest lands are used for mining, agriculture, grazing, and recreation and for development of dams.

Ecological uses

- While a typical tree produces commercial goods worth about \$590 it provides environmental services worth nearly \$ 196 to \$ 250. The ecological services provided by our forests may be summed up as follows:
 - Production of oxygen : The trees produce oxygen by photosynthesis which is so vital for life on this earth. They are rightly called as earth's lungs.
 - Reducing global warming : The main greenhouse gas carbon dioxide (CO₂) is absorbed by the forests as a raw material for photosynthesis. Thus forest canopy acts as a sink for CO₂ thereby reducing the problem of global warming caused by greenhouse gas i.e. CO₂.
 - Wild life habitat : Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone.
 - Regulation of hydrological cycle : Forested watersheds act like giant sponges, absorbing the rainfall, slowing down the runoff and slowly releasing the water for recharge of springs. About 50-80% of the moisture in the air above tropical forests comes from their transpiration which helps in bringing rains.
 - Soil Conservation : Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as windbreaks.
 - Pollution moderators : Forests can absorb many toxic gases and can help in keeping the air pure and clean. They have also been reported to absorb noise and thus help in preventing air and noise pollution.

OVER EXPLOITATION OF FORESTS:

- Since time immemorial, humans have depended heavily on forests for food, medicine, shelter, wood and fuel.
- With growing civilization the demands for raw material like timber, pulp, minerals, fuel wood etc. shot up resulting in large scale logging, mining, road-building and clearing of forests.
- Our forests contribute substantially to the national economy. The international timber trade alone is worth over US \$ 40 billion per year.
- Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and overgrazing have together led to over exploitation of our forests leading to their rapid degradation.

DEFORESTATION

- The total forest area of the world in 1990 was estimated to be 7000 million hectares which was reduced to 2890 million hectares in 1975 and fell down to just 2300 million hectares by 2000.
- Deforestation rate is relatively less intemperate countries, but it is very alarming in tropical countries where it is as high as 40-50 percent and at the present rate is it estimated that in the next 60years we would lose more than 90 percent of our tropical forests.
- The forested area in India seems to have stabilized since 1982 with about 0.04%decline annually between 1982-90. FAO (1983) estimated that about 1.44 mhectares of land were brought under afforestation during this period leading to stabilization.
- As per FAO estimates, the deforestation rate per unit population in India is the lowest among the major tropical countries, despite the fact that we have a huge population size and very low per capita forest area (0.075 ha per capita). However, we are still far behind the target of achieving 33% forest areas, as per our National Forest Policy, as we are still having only 19.27% of our land area (63.38m ha) covered by forests based on satellite data (MoFF, 1998).

Major causes of Deforestation:

- Shifting cultivation
 - There are an estimated 300 million people living as shifting cultivators who practice slash and burn agriculture and are supported so clear more than 5 lakh ha of forests for shifting cultivation annually. In India, we have this practice of North-East and to some extent in Andhra Pradesh, Bihar and M.P. which contribute to nearly half of the forest clearing annually
- Fuel requirements
 - Increasing demands for fuel wood by the growing population in India alone has shot up to 300-500 million tons in 2001 as compared to just 65 million tons during independence, thereby increasing the pressure on forests
- Raw materials for industrial use
 - Wood for making boxes, furniture, railway-sleepers, plywood, match boxes, pulp for paper industry etc. have exerted tremendous pressure on forests. Plywood is in great demand for packing tea for Tea industry of Assam while fir tree wood is exploited greatly for packing apples in J&K
- Development projects
 - Massive destruction of forests occur for various development projects like hydroelectric projects, big dams, road construction, mining etc
- Growing food needs
 - In developing countries this is the main reason for deforestation. To meet the demands of rapidly growing population, agricultural lands and settlements are created permanently by clearing forests
- Overgrazing
 - The poor in the tropics mainly rely on wood as a source of fuel leading to loss of tree cover and the cleared lands are turned into the grazing lands. Overgrazing by the cattle leads to further degradation of these lands

Major consequences of deforestation

- It threatens the existence of many wild life species due to destruction of their natural habitat.
- Biodiversity is lost and along with that genetic diversity is eroded.
- Hydrological cycle gets affected, thereby influencing rainfall.
- Problems of soil erosion and loss of soil fertility increase.
- In hilly areas it often leads to landslides

Major activities in Forests:

- Timber Extraction:
 - Logging for valuable timber, such as teak and Mahogany not only involves a few large trees per hectare but about a dozen more trees since they are strongly interlocked with each other by vines etc. Also road construction for making approach to the trees causes further damage to the forests.
- Mining:
 - Mining operations for extracting minerals and fossil fuels like coal often involves vast forest areas.
 - Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining.
 - More than 80000 ha of land of the country is presently under the stress of mining activities.
 - Mining and its associated activities require removal of vegetation along with underlying soil mantle and overlying rock masses.
 - This results in defacing the topography and destruction of the landscape in the area.
 - Large scale deforestation has been reported in Mussorie and Dehradun valley due to indiscriminating mining of various minerals over a length of about 40 Km.
 - The forested area has declined at an average rate of 33% and the increase in non-forest area due to mining activities has resulted in relatively unstable zones leading to landslides.
 - Indiscriminate mining in forests of Goa since 1961 has destroyed more than 50000 ha of forest land.
 - Coal mining in Jharia, Raniganj and Singrauli areas has caused extensive deforestation in Jharkhand.
 - Mining of magnesite and soap stones have destroyed 14 ha of forest in hill slopes of Khirakot, Kosi valley, Almora.
 - Mining of radioactive minerals in Kerala, Tamilnadu and Karnataka are posing similar threats of deforestation.
 - The rich forests of Western Ghats are also facing the same threat due to mining projects for excavation of copper, chromite, bauxite and magnetite.

WATER RESOURCES

- Water is an indispensable natural resource on this earth on which all life depends. About 97% of the earth's surface is covered by water and most of the animals and plants have 60-65% water in their body. Water is characterized by certain unique features which make it a marvelous resource:
 - It exists as a liquid over a wide range of temperature i.e. from 0 to 100 C.
 - It has the highest specific heat, due to which it warms up and cools down very slowly without causing shocks of temperature jerks to the aquatic life.
 - It has high latent heat of vaporization. Hence, it takes huge amount energy for getting vaporized. That's why it produces a cooling effect as it evaporates.
 - It is in an excellent solvent for several nutrients. Thus, it can serve as a very good carrier of nutrients, including oxygen, which are essential for life. But it can also easily dissolve various pollutants and become a carrier of pathogenic microorganisms.
 - Due to high surface tension and cohesion it can only easily rise through great heights through the trunk even in the tallest of the trees like Sequoia.
 - It has anomalous expansion behaviour i.e. as it freezes; it expands instead of contracting and thus becomes lighter. It is because of this property that even in extreme cold, the lakes freeze only on the surface. Being lighter the ice keeps floating, whereas the bottom waters remain at a higher temperature and therefore, can sustain aquatic organisms even in extreme cold. The water we use keeps on cycling endlessly through the environment, which we call as Hydrological Cycle.

- We have enormous resources of water on earth amounting to 1404 million km³.
- The water from various moist surfaces evaporates and fall again on the earth in the form of rain or snow and passes through living organisms and ultimately returns to oceans.
- Every year about 1.4inch thick layer of water evaporates from the oceans more than 90% of which returns to the oceans through the hydrological cycle.
- Solar energy drives the water cycle by evaporating it from various bodies, which subsequently return through rainfall or snow.
- Plants too play a very vital role by absorbing the groundwater from the soil and releasing it into the atmosphere by process of transpiration.
- Global distribution of water resources is quite uneven depending upon several geographic factors.
- Tropical rain forest areas receive maximum rainfall while the major world deserts occur in zones of dry, descending air (20-40 N and S) and receive very little rainfall.

WATER USE AND OVER-EXPLOITATION:

- Due to its unique properties water is of multiple uses for all living organisms.
 - Water is absolutely essential for life.
 - Most of the life processes take place in water in water contained in the body. Uptake of nutrients, their distribution in the body, regulation of temperature, and removal of wastes are all mediated through water.
- Water use by humans is of two types
 - Water withdrawal : taking water from groundwater or surface water resource and
 - Water consumption : the water which is taken up but not returned for reuse.

Water: A precious Natural Resource:

- Although water is very abundant on this earth, yet it is very precious.
- Out of the total water reserves of the world, about 97% is salty water (marine) and only 3% is fresh water.
- Even this small fraction of fresh water is not available to us most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of groundwater and surface water.
- Overuse of groundwater for drinking, irrigation and domestic purposes has resulted in rapid depletion of groundwater in various regions leading to lowering of water table and drying of wells.
- Pollution of many of the groundwater aquifers has made of these wells unfit for consumption.
- Rivers and streams have long been used for discharging the wastes. Most of the civilizations have grown and flourished on the banks of rivers, but unfortunately, growth in turn has been responsible for pollution of the rivers.

Groundwater:

- About 9.86% of the total fresh water resources is in the form of groundwater and it is about 35-50 times that of surface water supplies.
- Effects of groundwater usage:
 - Subsidence
 - Lowering of water table
 - Water logging

Surface water:

- The water coming through precipitation (rainfall, snow) when does not percolate down into the ground or does not return to the atmosphere as evaporation or transpiration loss, assumes the form of streams, lakes, ponds, wetlands or artificial reservoirs known as surface water.
- The surface water is largely used for irrigation, industrial use, public water supply, navigation etc.
- A country's economy is largely dependent upon its rivers.
- The problems arising out of water resources are floods, droughts.
- Apart from these there are conflicts over water. Indispensability of water and its unequal distribution has often led to inter-state or international disputes. Issues related to sharing of river water have been largely affecting our farmers and also shaking our governments. Some major water conflicts are-
 - Water conflict in the Middle East- countries involved as Sudan, Egypt, Turkey- it also affects countries who are water starved viz. Saudi Arabia, Kuwait, Syria, Israel and Jordan.
 - The Indus Water treaty-is dispute between India and Pakistan,
 - The Cauvery water dispute- involves two major southern states of India viz. Tamilnadu, Karnataka
 - similarly The Satluj-Yamuna link canal Dispute also involves two Northern states viz. Punjab and Haryana. Affected states also include UP, Rajasthan as well as Delhi.
 - In traditional water management, innovative arrangements ensure equitable distribution of water, which are democratically implemented. The 'gram sabhas'' approve these plans publicly.
 - While water disputes between states and nations often resume battle like situations, our traditional water managers in villages prove to be quite effective

BIG DAMS- BENEFITS AND PROBLEMS

- Benefits

- River valley projects with big dams have usually been considered a key role in the development process due to their multiple uses.
- India has the distinction of having the largest number of river valley projects.
- These dams are often regarded as a symbol of national development.
- There are hopes all over from every corner of the region where such dam is planned to be constructed.
- Such projects result providing much employment of opportunities, raise in the standard of living and improvement in quality of life.
- Such projects have tremendous potential for economic upliftment and growth.
- It can check floods and famines, generate electricity and reduce water and power shortage, provide irrigation water to lower areas, provide drinking water in remote areas and bring out overall development of the region

Environmental problems

- The environmental impacts of big dams are also too many due to which very often big dams become an issue of controversy. The impacts can be at the upstream as well as downstream levels.
- Upstream problems:
 - Displacement of tribal people
 - Loss of forests, flora and fauna
 - Changes in fisheries and the spawning grounds
 - Siltation and sedimentation of reservoirs
 - Loss of non-forest land
 - Stagnation and water logging near reservoir
 - Breeding of vectors and spread of vector-borne diseases
 - Reservoir induced seismicity (RIS) causing earthquakes
 - Growth of aquatic weeds
 - Microclimatic changes
- Downstream impacts:
 - Water logging and salinity due to over irrigation
 - Micro-climatic changes
 - Reduced water flow and silt deposition river
 - Flash floods
 - Salt water intrusion at river mouth
 - Loss of land fertility along the river since the sediments carrying nutrients get deposited in the reservoir
 - Outbreak of vector-borne diseases like malaria Thus dams are built to serve the society with multiple uses, but it has several serious side-effects. That it why now there is a shift towards construction of small dams or min-hydel projects.

MINERAL RESOURCES:

- Minerals are naturally occurring, inorganic, crystalline solids having definite chemical composition and characteristic physical properties.
- There are thousands of minerals occurring in different parts of the world. However, most of the rocks, we see everyday are just composed of few common minerals like quartz, feldspar, biotite etc.
- These minerals in turn are composed of some elements like silicon, oxygen, iron etc.
- Minerals are generally used for development of industrial plants, generation of energy, construction, equipments and armament for defence, transportation means, medical system, communication, jewellery- gold, silver etc.
- Environmental impacts of mineral extraction and use are de vegetation and defacing of landscape, subsidence of land, groundwater contamination, surface water pollution, air pollution, occupational health hazards etc. Remedial measures include adoption of eco-friendly technology, microbial leaching technique, restoration of mined areas by re-vegetating them with appropriate plant species, stabilization of the mined lands, gradual restoration of flora etc.

FOOD RESOURCES:

- There are thousands of edible plants and animals over the world out of which only about three dozen types constitute major food of humans.
- The main food resources include wheat, rice, maize, potato, barley, oats etc. about twenty or so common fruits and vegetables, milk, meat, fish and seafood. World food problems:
- Every year food problem is killing as many people as were killed by the atomic bomb dropped on Hiroshima during World War II.
- This shows that there is drastic need to increase food production, equitably distribute it and also to control population growth.
- Although India is the third largest producer of staple crops, an estimated 300 million Indians are still undernourished. India has only half as much land as USA, but it has nearly three times population to feed.

- Our food problems are directly related to population. Because of overgrazing the agricultural land gets affected as follows, it results into:
 - Land degradation
 - Soil erosion
 - Loss of useful species
- Agriculture also makes impact on the usage of land generally as follows:
 - Deforestation
 - Soil Erosion
 - Depletion of nutrients
- Impact of modern agriculture is as follows: There is
 - Impact related to high yielding varieties (HYV)
 - Fertilizers related problems include micronutrient imbalance, nitrite pollution, eutrophication
- Pesticide related problems include creating resistance in pests and producing new pests, death of non-target organisms, biological magnification.
- Some other problems include water logging, salinity problems and such others.

ENERGY RESOURCES:

- Energy consumption of a nation is usually considered as an index of its development. This is because almost all the development activities are directly or indirectly dependent upon energy.
- There are wide disparities in per capita energy use between developed and the developing nations.
- The very original form of energy technology probably was the fire, which produced heat and the early man used it for cooking and heating purposes.
- Wind and hydropower has also been used. Invention of steam engines replaced the burning of wood by coal and coal was further replaced by oil.
- The oil producing have started twisting arms of the developed as well as developing countries by dictating the prices of oil and other petroleum products.
- Energy resources are primarily divided into two categories viz. renewable and non-renewable sources.
- Renewable energy resources must be preferred over the non-renewable resources. This will seek to end the energy crisis which the world is facing today. It is inevitable truth that now there is an urgent need of thinking in terms of alternative sources of energy, which are also termed as non-conventional energy sources which include: 1.
 - solar energy- made up equipments such has solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace, solar power plants are must.
 - Wind energy
 - Hydropower, Tidal energy, ocean thermal energy, geothermal energy, biomass, biogas, biofuels etc.
- The non renewable energy sources include coal, petroleum, natural gas, nuclear energy.

LAND RESOURCES: Land as a resource:

- Land is a finite and valuable resource upon which we depend for our food, fiber and fuel wood, the basic amenities of life. Soil is also a valuable resource.

Land Degradation:

- Because of increasing of population growth the demands for arable land for producing food and fuel wood is also increasing. Hence there is more and more pressure on the limited land resources which are getting degraded due to over-exploitation. Soil erosion, water logging, salinization and contamination of the soil with industrial wastes like fly-ash, press mud or heavy metals all cause degradation of land.
- Soil Erosion:
 - Soil erosion means wearing away of soil. It defined as the movement of soil components, especially surface-litter and top soil from one place to another. It results in the loss of fertility. It basically of two types viz, normal erosion go geologic erosion and accelerated erosion. The agents that cause such erosion are- climatic agents and water induced erosion, biotic agents. Wind is also responsible for the land erosion through saltation, suspension and surface creep.
- In order to prevent soil erosion and conserve the soil the following conservation practices are employed:
 - Conservational till farming.
 - Contour farming
 - Terracing
 - Strip cropping
 - Strip cropping
 - Alley cropping
 - Wind breaks or shelterbelts
 - Water logging
- Landslides:
 - Various anthropogenic activities like hydroelectric projects, large dams, reservoirs, construction of roads and railway lines, construction of buildings, mining etc. are responsible for clearing of large forested areas.
- Desertification:
 - Desertification is a process whereby the productive potential of arid or semiarid lands falls by ten percent or more. Desertification is characterized by de vegetation and loss of vegetal over, depletion of groundwater, salinization and severe soil erosion.