UNIT 3

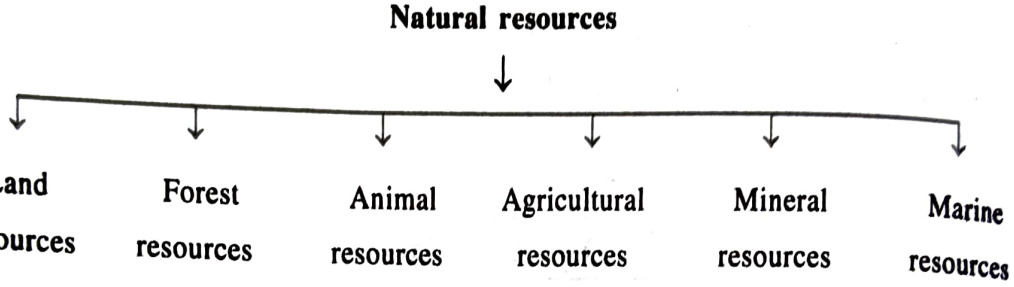
NATURAL RESOURCES

3.1 NATURAL RESOURCES :

Any component of the natural environment that can be utilized by living organisms for their survival and welfare directly from the natural environment, are called **natural resources.**

These are basically resources gifted by nature to us like,

- Sun light
- Water
- Soil and minerals
- Air
- Plants and animals



Natural resources like wind, water, forests, etc. existed on earth much before man came into being. But excessive and unplanned use of these resources has depleted these resources so much that there is an urgent need for their conservation. The main objective of the conservation of natural resources is to preserve the quality of environment and allowing natural cycle of renewal.

➧ Importance of natural resources :

Natural resources are the potential forms of wealth supplied by nature. The environment is a huge pool of natural resources. Natural resources are considered as a gift of nature to human beings and other living organisms for fulfilling their needs and desires.

The importance of natural resources can be summarised as follows :

1. All living beings use natural air to breathe.
2. All living beings use land for getting shelter.
3. All humans, animals, birds and other living organisms use water to drink.
4. Natural resources like forests provide timber, food, fresh air, paper, medicines etc.
5. Natural resources like gas, minerals and metals are necessary for economic development of a country.
6. Natural resources like coal give energy to us.

3.1.1 CLASSIFICATION OF NATURAL RESOURCES :

- The natural resources can be broadly divided into two categories :

Natural Resources

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Biotic (living) resources	**Abiotic (non-living) resources**
e.g. • Forest	e.g. • Land
• Wildlife	• Water
• Agriculture	• Minerals
• Fish, etc.	• Metals
	• Natural gas, etc.

- Based on its availability and reusability, the natural resources are classified as under : **(Dec. 2011)**

Natural Resources

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Renewable resources (In-exhaustible resources)	Non-renewable resources (exhaustible resources)
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	Recyclable / Non-recyclable

1. Renewable resources :

These are the natural resources which can regenerate/replenish on their own, through natural cycles (bio-geochemical and physical cycles) within a reasonable time period.

These resources are also called **inexhaustible resources.**

For example,

- Sunlight, air
- Soil, water
- Tidal and hydro power
- Plants and animals, birds
- Wind, rainfall,

2. Non-renewable resources :

These are the natural resources which do not regenerate or replenish on their own or regenerate very slowly. Resources which are in limited supply and cannot be replaced on human time scale are called non-renewable resources.

These resources are also called **exhaustible resources.**

For example,

- Fossil fuels such as coal, petroleum, natural gas
- oils
- metals
- minerals

As per the possibility of recycling, non-renewable resources may be further divided into two types as :

(a) Recyclable resources :

These are the resources which can be reprocessed after collection to new products.

For example,

- ores of metals
- nutrient rocks (phosphorus, sulphur, calcium)

(b) Non-recyclable resources :

These are the resources which can not be reprocessed for recycling or reuse and are lost after giving energy.

For example,

- Fossil fuels (coal, oil, petroleum, natural gas)
- uranium, thorium, etc.

- Another classification of natural resources is as under :

Natural Resources

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External resources	**Internal resources**
e.g. Land, soil, surface water, air, plants, animals, humans, solar energy, wind energy, etc.	e.g. Fossil fuels (like coal, gas, oil) ground water, ores, minerals, thermal energy

3.2 LAND RESOURCES:

All human and natural activities require space for their location and development, which is provided by land surface.

Various uses of land are :

1. Residential purposes – to build different types of domestic buildings.
2. Commercial purposes – to build commercial centres.
3. Food production – by carrying out different agricultural activities.
4. Providing shelter for living beings

5. Industrial purposes – to install different types of industries.
6. Forestation purposes – which provide shelter and food for animals, birds and other living beings.
7. Transportation purposes – construction of roads, railway lines, airports, etc.
8. Construction of irrigation structures – dams and canals
9. Thermal power stations.
10. Disposal of solid and liquid wastes.

Though the pattern of land use varies from country to country; broadly, the pattern of land use on earth is as under :

Pattern of land use	% land use
Agricultural land	11 %
Pastures and meadows	22 %
Forest land	30 %
Urban and non-agricultural land	37 %
	Total = 100 %

- **Land abuses :**

1. The fertile lands are used either for industries or for residential purposes, which may be called as abuse of land from environment perspectives.
2. Production of bricks in fertile land is also the abuse of land.
3. Excavation of soil from fertile land for the construction of highway or railway embankment is also the abuse of land.
4. Deforestation
5. Overgrazing
6. Mining and quarrying
7. Overuse of irrigation water

3.2.1 Land Degradation :

The deterioration in the quality of land and reduction in its fertility and productivity is called land degradation.

Land degradation is defined as the temporary or permanent decline in the productive capacity of the land, and the diminution of the productive potential, including its major land uses (e.g., rain-fed arable, irrigation, forests), its farming systems (e.g., smallholder subsistence), and its value as an economic resource.

- The factors causing land degradation are :

1. Soil pollution.
2. Soil erosion.

3. Salination and water logging.
4. Shifting cultivation.
5. Desertification.
6. Urbanisation.

3.2.2 Soil erosion :

Loss or removal of the top layer of the soil by the action of water, wind or by the activities of man is termed as soil erosion.

Factors affecting soil erosion are :

- **Amount, intensity and distribution of rainfall :**

  Very high rainfall in short duration and intensive rainfall causes more soil erosion.

- **Slope of the ground :**

  The ground with steep slope causes more soil erosion.

- **Nature of soil :**

  Soil erosion will be more in case of loose soil than dense and heavier soils.

- **Vegetation cover :**

  Vegetation cover reduce the run off and prevent soil erosion.

- **Soil mismanagement :**
  - Wrong methods of cultivation
  - Faulty methods of surface irrigation
  - Over grazing
  - Forest fires, deforestation, etc.

- **Salination and waterlogging :**

Increase in the concentration of soluble salts in the soil is called salination. It adversely affects soil productivity and degrades the quality of land. Salination is caused by a number of processes.

1. Due to poor drainage, salts from irrigation and flood water will accumulate on the soil surface.
2. The salts from the lower layers move up by capillary action in summer and are deposited on the surface.
3. In coastal regions, winds bring lot of salt from raw water to land, thus causing salination of the soil.
4. Excessive use of alkaline fertilizers such as sodium, nitrate may cause salination of the soil.

3.3 FOREST RESOURCES :

A forest is defined as an ecosystem or assemblage of ecosystems dominated by trees and other woody vegetation.

A forest consists of biotic (living) and abiotic (non-living) components.

Components of Forest

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Biotic component (living)

It includes

- trees, shurbs, herbs
- grass
- animals
- birds, etc.

Abiotic component (Non-living)

It includes

- water
- sunlight
- air
- land
- nutrients, etc.

Definition of forest as per FAO-UN :

The FAO (Food and Agriculture Organization of UN) defines forest as :

A land with tree crown cover of more than 10%, and area of more than 0.5 hectare (1 hectare = 10,000 m^2) is treated as forest.

- **Forest resources – Indian scenario :**

India is one of the most diverse countries with rich bio-diversity. The forests cover of India is monitored by the Forest Survey of India a government of India organization, through biennial assessment using remote sensing technology. The details of the forest cover assessment are given below in the Table 3.1.

Table 3.1 : Forest Class and their geographic area in percentage and Sq. Km

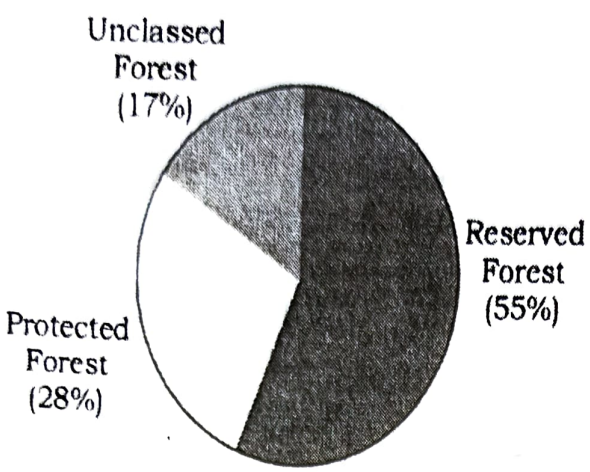
Class	Area (Km^2)	% of Geographic Area
Dense forest[1]	416,809	12.68
Total Forest Cover[2]	6,75,538	20.55
Mangrove[3]	4,871	0.1
Scrub[3]	47,318	1.44
Non-forest (other land use)	2,611,725	79.45
Total	**3,287,263**	**100**

[1]Canopy cover > 40% of land :

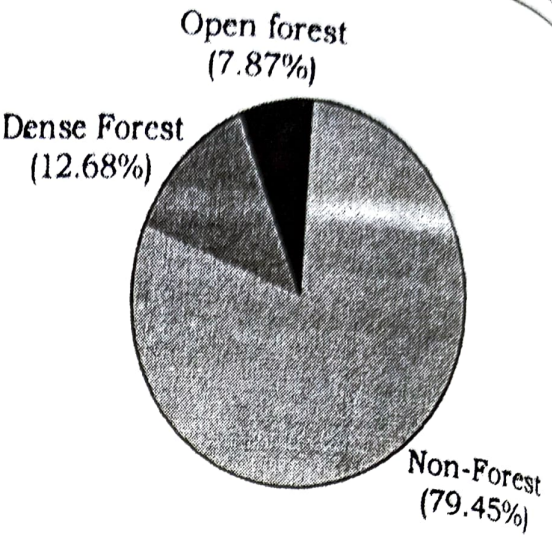
[2]Canopy cover 10-40% of land;

[3]Canopy < 10% of land.

The total forest cover of the country has been estimated to be 63.73 million hectare which is 19.39% of the geographic area. The dense forests (with crown density more than 40%) and open forests (crown density 10 to 40%) occupy about 11% and 8% of the geographic area respectively. Mangrove forests occurring along the intertidal coastal region occupy 0.15% of the geographic area.



(A) RECORDED FOREST ARES IN INDIA (BASED ON FSI 2001)



(B) FOREST COVER IN INDIA (BASED ON FSI 2001)

[FIG. 3.1 INDIAN SCENARIO OF FOREST BY FSI 2001]

There is great variety of vegetation types throughout the country as given below.

Table 3.2 Types of Forest in India

Types of forest	States
1. Rain evergreen forest	Western Ghats
2. Tropical wet evergreen forest	Kerala, Assam
3. Tropical deciduous forest	Gujarat, Rajasthan
4. Broad leaves deciduous forest	Himalaya
5. Coniferous deciduous forest	U.P., H.P., J & K
6. Mangrove forest	coastal areas

3.3.1 Importance of Forests :

The function of forest may broadly be classified into following categories.

(i) Protective function :

These include the protective roles of forest against soil erosion, droughts, floods, radiation, noise, smells etc.

(ii) Productive function :

These include the source of wood and many other products like gums, resins, medicines, katha, honey, pulp, paper, bamboos, timber and food.

(iii) Regulative function :

The regulative function include absorption, storage and release of gases like CO_2 and O_2, water, mineral elements. The main regulative function is to regulate the carbon cycle, droughts and floods. The regulative function of forests improve atmospheric and temperature conditions and enhance economic and environmental value of landscape.

(iv) **Accessory function :**

These include the role of forests in recreation, aesthetics and habitat of various types of flora and fauna.

(I) **Ecological Importance or uses of forests :**

Forests are home to 50-90% of earth's species and are potentially renewable resources if used as per optimum need and ensuring their security known as sustainability. This invaluable renewable natural resource is providing a great environmental ecological service to living organisms as stated below.

(i) **Regulation of global climate and temperature :**

Forest play a crucial role in regulation of global climate and temperature as the forest cover absorbs the solar energy for primary production of food and energy that would otherwise be reflected back into the atmosphere by bare surface of the earth. Transpiration of plants increases the atmospheric humidity which affect the rainfall, cools the atmosphere thus regulates the hydrological cycle.

(ii) **Reduction in Global Warming :**

The main greenhouse gas CO_2 is used by forests for photosynthesis process. The forest canopy acts as a sink for CO_2 thereby reducing the greenhouse effect due to CO_2.

(iii) **Production of Oxygen :**

During photosynthesis process forest release oxygen, a very important gas for human being to the atmosphere and balancing the O_2 in biosphere. Therefore they are called as lungs of earth.

(iv) **Conservation of soil :**

They prevent soil erosion by binding the soil particles tightly in their roots. They also reduce the velocity of wind and rain which are the chief agents causing erosion.

(v) **Improvement in fertility of soil :**

The fertility of soil increases due to the humus formed by the decay of forest litter.

(vi) **Control of water flow :**

The forest water sheds (thick humus) act as a giant sponge, slowing down runoff, absorbing and holding water that recharges springs, streams and ground water, this avoids flash floods.

(vii) **Habitat to wildlife :**

They provide the habitats for high wildlife species diversity than any oher biosphere, About 7 million species are found in the tropical forests alone.

(viii) **Absorption of Noise :**

Forests cover absorbs the noise and helps in preventing noise pollution.

(ix) **Absorption of air pollution :**

Forests can absorb many toxic gases and air pollutants and can help in keeping the air pure.

(II) Economical importance OR uses of forests :

Forests are the most valuable natural resources available to mankind on planet earth. They are very useful to mankind economically by providing varieties of forests products used by mankind in different ways.

- **Use of forests products :**

(1) Timber :

Wood used for engineering purposes like building houses, making furniture etc. is called timber. The timber used for making furnitre and other desired items, like boats, bridges, railway sleepers and other day to day uses.

(2) Fuel food :

The wood is used as fuel for the cooking and other purposes by poor people.

(3) Raw material for wood based industries :

Forest provide raw material for various wood based industries like pulp and paper, composite wood, rayon, other man-made fibres, sport goods, furniture, boat building, matchbox etc.

(4) Bamboo :

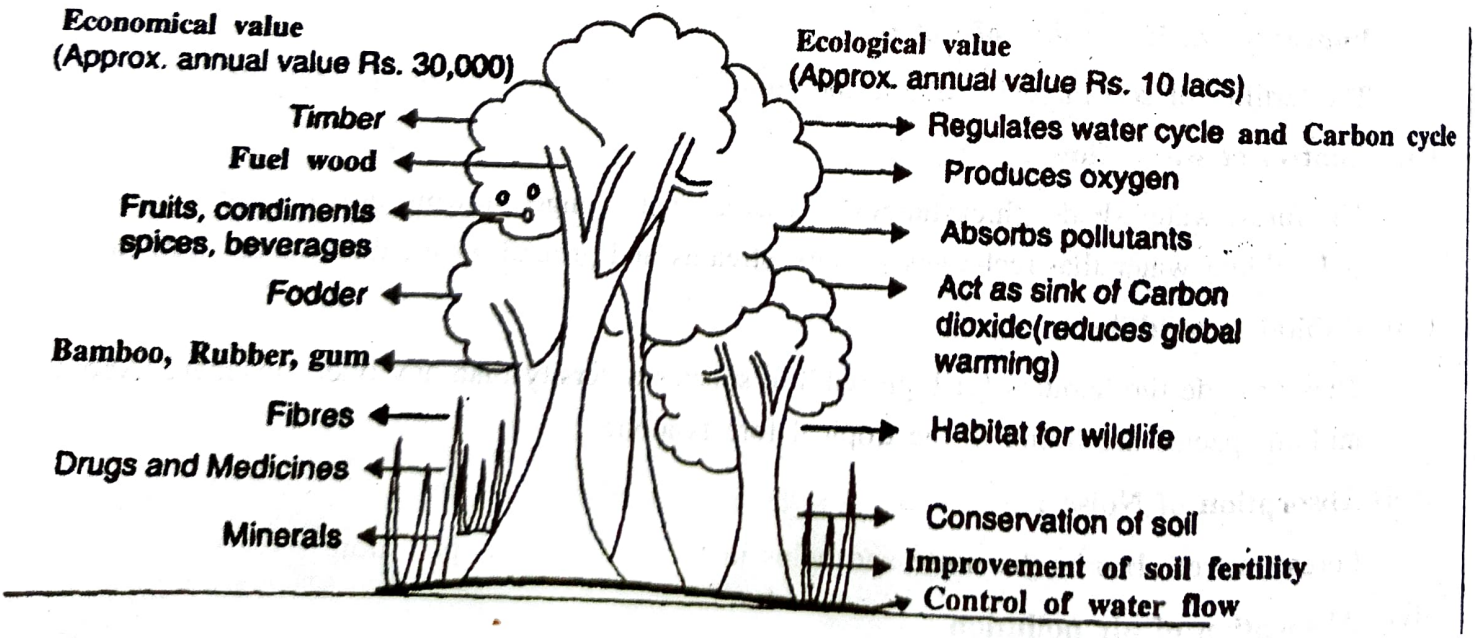
These are used for matting flooring, baskets, ropes, cots etc.

(5) Food :

Fruits, roots, leaves of plants and trees along with meat of forest animals provides the food to the tribal people.

(6) Miscellaneous products :

Miscellaneous products like resins, gums, some oils, fibres, medicines, katha, lac, waxes, honey, insecticides, rubber, fodder are provided by flora and fauna of forest. The following figure 3.2 explains the importance of forest resources ecologically and economically.



[FIG. 3.2 IMPORTANCE OF FOREST RESOURCES]

3.3.2 Deforestation :

Deforestation refers to the long term or permanent loss of forest cover. A 10% loss of canopy is considered as deforestation.

The difference between forests and woodlands is that in a forest the crowns of individual trees touch to form a single canopy, while in a woodland, trees grow far apart, so that canopy is open.

Deforestation causes deterioration of our environment and thus degradation in the quality of life and economy. There is sharp reduction in the world's forest cover especially in the developing countries in the tropic areas. Tropical forests have lost around 40% of its area compared to 1% lost in the area of temperate forests.

- **Causes of Deforestation :**

(1) Population explosion :

Population explosion is the root cause of all the environmental problems. Vast area of forests are cleared for the human settlement (factories, houses, agriculture, road, railway tracks etc.)

(2) Shifting Cultivation :

It is a traditional agroforestry system widely practiced in north eastern region of country in which felling and burning of forests followed by cultivation of crops for few years and abandoning of cultivation allow forests for re-growth cause extreme damage to forests.

(3) Growing food demand :

To meet the food demand of rapidly growing population, more and more forests are cleared off for agricultural purpose.

- **Effects of deforestation :**

The major effects may be listed as follows :

1. Destruction of natural habitats of many wildlife species resulting in extinction of some of the species. In particular migratory birds suffer due to loss of their habitat.
2. Loss of Bio-diversity along with the loss of cultural diversity (Tribals).
3. Increases the soil erosion due to reduction of vegetation cover.
4. Loss of soil fertility due to rapid leaching of essential mineral nutrients.
5. In hilly region it may lead to landslides.
6. Reduction in the oxygen liberated by trees.
7. Increase in pollution due to burning of fuel wood and less fixation of carbon dioxide by plants. As more carbon is added to atmosphere, global warming is enhanced.
8. Local and global climate changes may occur, Hydrological cycle and Carbon cycle gets affected.
9. Decreases the amount of forest products available from forest for human needs.
10. Lowering of the water table due to more surface run off.
11. Scarcity of fuel wood results in deterioration of quality of life of people residing near forests.

- **Measures to check deforestation :**
  - Prevent shifting cultivation
  - Make use of wood substitute in buildings.
  - Prevent man made forest fires.
  - Restrict mining activities in forest.
  - For effective forest management take the confidence of tribals.

3.4 WATER RESOURCES :

Water is a vital natural resource which forms the basis of all life. It is one of the marvelous gift of nature to us. One can live for a month without food but cannot survive for more than three to five days without water. Water is absolutely fundamental to life.

The world's total water resources are estimated at 1.38×10^8 M ha-m. Of these global water resources the water storage distribution is as follows.

Seas and Oceans	97%
At poles as frozon ice	2%
Ground water	0.75%
Rivers and lakes	0.25%
Total =	100%

On the surface area of earth only 29% is occupied by land and the remaining 71% is covered by seas and oceans.

It has been estimated that the total water content on earth (in the hydrosphere) is about 1.4 billion cubic km.

3.4.1 Sources of water :

There are two types of water sources available on earth.

1. Surface water sources
2. Ground water sources

Sources of water

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Surface water sources

- Lakes
- Ponds
- Streams
- Rivers
- Storage reservoir

Ground water sources

- Infiltration well
- Infiltration gallery
- Springs
- Wells
  - open well
  - Tube well
  - Artesian well
  - French well

(a) Surface water sources :

1. Lakes :

These are natural large sized depressions formed within the surface of earth and filled with rainwater. The quality of water in a lake is generally good and does not need much purification. Larger and older lakes provide comparatively purer water than the smaller and newer lakes. In lakes, growth of algae and some water vegetables are generally common.

Famous lakes in India are :

Dal lake	–	Jammu & Kashmir
Dhebar lake	–	Rajasthan
Nakhi lake	–	Rajasthan
Pushkar lake	–	Rajasthan
Nal sarovar	–	Gujarat
Hussain Sagar	–	Andhra Pradesh
Pulicat	–	Tamilnadu
Kolleru	–	Andhra Pradesh
Chilka	–	Orissa
Vembanad	–	Kerala

2. Ponds :

Ponds are also natural inland depressions filled with rainwater but are small and shallow water bodies compared to lake.

3. Streams :

Streams are formed by the small amount of water running down the hills joining to rivers or lakes. The quantity of water available in them is very small and sometimes they may go dry.

4. Rivers :

When number of streams combine together, a river is formed. Rivers are the most important sources of water for public water supply schemes.

The quality of water available from river is quite variable as in monsoon season, water is highly turbid compared to non-monsoon season.

5. Storage reservoirs :

Storage reservoirs are formed by constructing dams across the river valley. Huge quality of water is stored in the reservoir formed upstream of the dam. Various uses of storage reservoirs are :

- Public water supply
- Irrigation
- Power generation
- Flood control, etc.

(b) Ground water sources :

1. Infiltration well :

For tapping water from sandy river beds the infiltration wells are sunk in series in sandy river beds. These are constructed of brick masonry with open joints. The water percolates through these joints and gets collected in the wells. The top of the wells are covered with R.C.C. slab having manhole for inspection.

The water from the infiltration wells gets collected in a jack well. Then the water from the jack well is pumped out and stored in a storage reservoir. The quantity of water so obtained is good and it requires no treatment. The quantity of water from this source is suitable for small water supply schemes.

2. Infiltration gallery :

For tapping water from sandy river beds sometimes horizontal tunnels are constructed in the river bed at shallow depths (3 to 5 cm) along the banks of the river. The walls of the tunnel are constructed of brick masonary and its top is convered with R.C.C. slab having manholes at some interval.

The perforated pipes are connected to the tunnel through which the water gets collected inside the tunnel. This tunnel is known as infiltration gallery.

Shallow wells are those which rest in the top water bearing strata and draw their supplies from the surounding material.

A deep well is a well which rest on impervious layer (mota layer) and draw their supplies from the pervious formation lying below the mota layer. The impervious layer is generally known as a mota layer and it is a layer of clay, cemented sand, kankar or other hard materials. The mota layer gives structural support to the open well.

3.4.2 Uses of water :

The use of water may be broadly divided into three categories as under :

Uses of Water

Consumptive use	**Partial consumptive use**	**Non-consumptive use**
– Irrigation use	– Domestic use	– Navigational use
	– Industrial use	– Recreational use
	– Institutional use	– Hydro electric power generation
	– Public use	– Pollution control
	– Fire demand	

(a) Consumptive use :

The quantity of water utilised or consumed for irrigation purposes is known as consumptive use.

Water is required for the growth of crops and vegetation. The quantity of water required for irrigation depends upon the type of crop, season, etc. Plants extract water from the ground through the root system. The water need for rice and sugar cane is two to four time more than that of wheat.

The loss of water due to heat of sun from the surface of the water bodies (ocean, rivers, lakes) and from the ground surface is termed as evaporation.

Transpiration is the process of water being lost from the leaves of the plants from their pores.

Evapotranspiration is the sum of the water lost to the atmosphere by the plants through transpiration and the water evaporated from the soil or water body surrounding the plant.

$\therefore$ Evapotranspiration = evaporation + transpiration

(b) Partial consumptive use :

When water is partly consumed and a portion of it is wasted as used water, the use is called partial consumptive use.

The partial consumptive use includes :

1. Domestic use
2. Industrial use
3. Institutional use
4. Public use
5. Fire demand

1. Domestic use :

The domestic or residential use includes water requirements for drinking, bathing, cooking, washing of clothes, utensils and house, lawn sprinkling, gardening, sanitary purposes, etc.

The quantity of water required for domestic use mainly depends on the habits, social status, climatic conditions and customs of the people.

As Per IS : 1172-1993, the minimum domestic consumption for a town or city with full flushing system should be taken as 200/h/d; although it can be reduced to 135 l/h/d for economically weaker sections. In developed countries like U.S.A. this figure may be as high as 350 l/h/d.

The break up of 135 l/h/d may be taken as shown in Table 3.3.

Table 3.3 Minimum Domestic water consumption in an Indian City

Use	Consumption in litres/head/day
(a) Drinking	5
(b) Cooking	5
(c) Bathing	55
(d) Washing of clothes	20
(e) Washing of utensils	10
(f) Washing and cleaning of houses and residences	10
(g) Flushing of water closets, etc.	30
Total	**135**

The total domestic water consumption usually amonts to 50 to 60% of the total water consumption.

2. Industrial use :

The "industrial water demand" represents the water demand of industries, which are either existing or are likely to be started in future, in the city for which water supply is being planned. The quantity of water required depends upon the number and types of industries present in the city.

The ordinary per capita consumption on account of industrial needs of a city is generally taken as 50 litre/person/day.

The quantity of water demand for industrial purposes is around 20 to 25% of the total demand of the city.

3. Institutional use and commercial use :

The institutional and commercial centres include office building, warehouse, store, shopping centres, schools, hospitals, hotels, hostels, colleges, railway station, bus station, cinema house, etc.

The water requirements of institutional and commercial places may be taken on an average 20 litre/capita/day.

4. Public use :

Quantity of water required for public utility purposes such as for washing and sprinkling of roads, cleaning of sewers, watering of public parks, gardens, public fountains, etc. comes under public uses or civic uses.

To meet the water demand for public use provision of 5% of the total consumption is made while designing the water works for a city. A figure of 10 l/h/d is usually added on this account, while computing total water requirement.

The requirements of water for public purposes shall be taken as given in Table 3.4.

Table 3.4 Water requirements for public purpose

Purpose	Water requirements
1. Public parks	1.4 litres/m^2/day
2. Street washing	1.0–1.5 litres/m^2/day
3. Sewer cleaning	4.5 litres/head/day

5. Fire demand :

Fire generally break in thickly populated localities and the industrial area and cause serious damages of properties and sometimes lives of the people are lost.

A provision should, therefore be made in modern public water supply schemes for fighting fires. The quantity of water required for extinguishing fires should be easily available and kept always stored in strorage reservoirs. Fire hydrants are usually fitted in the water mains at about 100 to 150 m apart, and fire-fighting pumps are immediately connected into them, by the fire brigade personnel, as soon as fire breaks out. The minimum water pressure available at fire hydrants should be of the order of 1.0 to 1.5 kg/cm^2 and should be maintained even after 4 to 5 hours of constant use of fire hydrant.

3.4.3 Overuse of water resorces :

Rapid population growth and increasing water consumption for agriculture, industry and domestic purposes have strained the world's fresh water resources.

The industrial use of water some time is reflected as over use of water, as sugar factories, paper mills, etc. consume high amount of water. Also the usage of water in thermal power plants for cooling tower is much.

Due to expanding human population, competition for water is growing such that many of the world's aquifers are becoming depleted. This is due to both direct human consumption as well as agricultural irrigation by ground water.

Water disputes between the Indian states are increasing as they have to meet the increase in water demand due to overuse of water.

Wherever surface water storage or canal irrigation is absent or limited, there is a greater activity of ground water by digging wells. The density of irrigation wells has grown very critically in some watersheds causing serious problems of water scarcity.

Expansion of business activities from industrialized to services such as tourism and entertainment, requires increased water services including both supply and sanitation.

- **Problem due to over exploitation of water resources :**

1. **Surface water :**

Overuse of surface water creates the following problems :

- Decrease in the flow of water in rivers
- Drying up of non-perennial rivers
- Drying of lakes and ponds particularly in summer.
- Reduction in the surface area of wet lands.
- Water logging
- Migration of people
- Desertification of soil

2. **Ground water :**

Overuse of ground water creates the following problems :

- Drying up of springs and shallow wells
- Increased salinity
- Increase in pumping costs as the water table lowers.
- Depletion of water in aquifers due to heavy pumping
- Sea water intrusion in coastal areas.
- Decrease in the production due to scarcity of irrigation water.

3.4.4 Ill-effects of floods :

The ill-effects of floods can be classified into the following three groups :

1. Inundation of low lying areas
2. Erosion of river banks
3. Change of river course

1. Inundation of low lying areas :

The following factors may cause the inundation of low lying areas :

(i) excessive runoff and inadequate channel capacity

(ii) Presence of obstructions in the stream

(iii) Inadequate waterway due to rail, road or canal crossing.

(iv) Congestion of confluences

(v) Tides resisting flood flows

2. Erosion of river banks :

The fast flowing current may eat away the banks, formed of easily erodable soil and thus may affect vast stretches of agricultural land.

3. Change in river course :

The change in the course of the river may develop due to the following reasons :

(i) Due to high velocities of the river water

(ii) Due to abrupt variation in the bed gradient and heavy sediment charge.

(iii) Due to oscillatory bed of the river

- **Flood Damages :**

Flood damages can be classified into two groups :

1. Direct damage
2. Indirect damage

1. Direct damage :

It implies damage due to physical contact with water. For example,

- Erosion of agricultural land
- Loss of human life and animals
- Loss of property
- Breach of roads, canals, ponds, etc.
- Loss of forest and wild life

2. Indirect damages :

In this case flood water does not come in direct contact of the property, etc. but causes damage by interruption and other causes.

For example,

- a labour is put out of employment or work due to submergence of the factory.
- Schools and colleges remains closed for few days due to flood.
- Due to interruption of transportation services, businees industry is affected.

3.4.5 Drought :

A drought is an extended period of months or years when a region notes a deficiency in its water supply whether surface or underground water. Generally, this occurs when a region receives consistently below average precipitations. It can have a substantial impact on the ecosystem and agriculture of the affected region. Although droughts can persist for several years, even a short, intense drought can cause sigificant damage and harm the local economy.

This global phenomenon has widespread impact on agriculture. Lengthy periods of drought have long been a reason for mass migration and played a key role in a number of ongoing migrations and other humanitarian criss.

Drought is stable, insidious natural hazard that is a normal part of the climate of virtually all regions of the world. Its occurence results in a myriad of economic, social and environmental impacts in developed as well as developing nations, although the characteristics of its impacts differ from region to region.

Drought is considered by many to be the most complex but least understood of all natural hazards, affecting more people than any other. It is a normal feature of climate and its recurrance is inevitable. However, there remains much confusion about its characteristics. It is precisely this confusion that explains, to some extent, the lack of emphasis on proactive drought management effort in most parts of the world. Through an improved understanding of the inevitabilty and characteristics of drought, as well as its difference from other natural hazards, scientists, policymakers and the public will be better equipped to establish much-needed polices and plans whereby future vulnerability to drought can be reduced.

Thus,

"Drought is a condition of water deficit sufficient to have an adverse effect on vegetation, animals and man over a sizeable area."

Country's experience is that :

- Drought can be prevented
- Drought can be mitigated
- Hardships can be minimized
- Sufferings can be reduced

If we work together at all levels, drought is not a disaster, but a management issue.

Causes of Drought :

The various causes of drought are :

1. Amount of water vapour in the atmosphere :

Amount of water vapour in the atmosphere is the most important cause of drought as it creates precipitation. More rain, sleet, hail and snow can occur where there are moist, low pressure air systems. If there is an above average presence of dry, high pressure air systems instead, less moisture is available to produce precipitation, because dry, high pressure air systems cannot hold as much water vapour.

2. Shifting of air masses :

When winds shift air masses and warm, dry, continental air moves over an area as opposed to cooler, moist oceanic air masses, the area suffered a drought.

3. Cold and warm water ocean currents :

Unusual currents of cold and warm water in the ocean can also create a high pressure system. In the Pacific ocean, a warm water current known as EI Nino brings low pressure systems that cause hurricanes and other violent storms to North America. On the other hand, the cold water current known as La Nina brings drought. In Asia, the opposite occurs, with EI Nino bringing drought and this reversed air flow causes droughts in India.

4. Mountains :

Higher mountain ranges near ocean are also responsible for drought on the leeward side of the mountains. Moisture loaded wind blowing from ocean surface to the land, strikes the barriers like mountains, rises up, becomes colder and the vapour condenses into rain on the windward side. When the air mass passes over the mountain, it has lost much of its vapour. Hence, the leeward side gets very less rainfall.

5. Human activities :

Human activity can directly trigger exacerbating factors such as

- Deforestation for agriculture
- Over farming
- Excessive irrigation
- Construction of buildings, etc.

adversely affect the ability of the land to capture and hold moisture. Activities resulting in global climate change are expected to trigger droughts.

6. Global Warming :

Overall global warming will result in increased world rainfall along with drought in some areas and flooding and erosion in others.

Effects of Drought :

Drought produces as large number of impacts that affects the social, environmental and economical standard of living. Its effects spread far beyond the physical effects of drought itself. Water is integral to produce goods and provide certain services.

Some direct consequences (impacts) of draught are :

- reduction in crop yield.
- reduced water levels.
- increased livestock and wildlife death rates
- damage to wildlife and fish habitat
- increased prices for food
- unemployment
- Migration, etc.

3.5 CLASSIFICATION OF ENERGY :

Energy

According to Sources

Coventional energy sources

- Fossil fuel
- Coal
- Oil
- Gas
- Timber

Nonconventional energy sources

- Solar Energy
- Atomic Energy
- Wind Energy
- Ocean Energy
- Cattle Energy
- Geothermal Energy

According to renewable property

Nonrenewable sources

- Coal
- Oil
- Gas
- Petroleum
- Nuclear fuel
- Bio mass Energy
- Bio-gas Energy
- Bio fuel Energy

Renewable sources

- Solar Energy
- Wind Energy
- Ocean-Thermal Energy
- Tidal Energy
- Geo-Thermal Energy

According to use

Commercial Energy

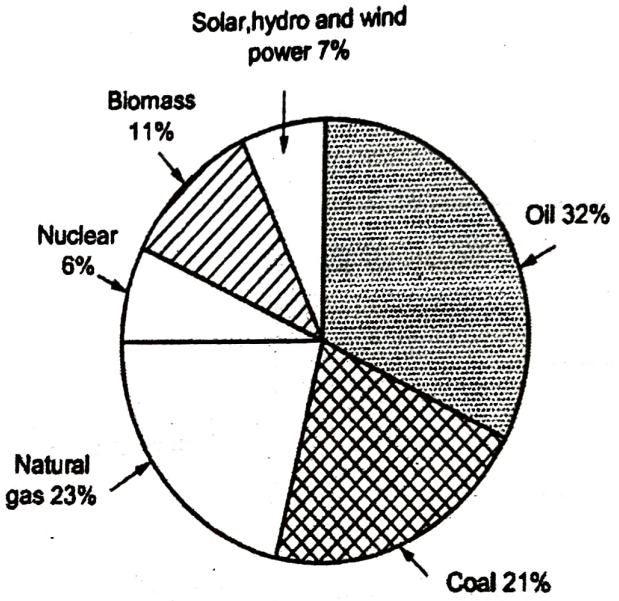
- Coal, petroleum and its products, natural gas
- Solar, wind, water energy and bio-mass

Non-commercial Energy

- Fuel wood and agricultural residues
- Animal energy

Table 3.5 World wide total energy use

Energy Source	% of total energy
(a) **Non-renewable energy sources :**	
Oil	32
Coal	21
Natural gas	23
Nuclear	06
(b) **Renewable energy sources :**	
Biomass	11
Solar, hydropower, wind power, etc.	07
Total	**100%**



(FIG. 3.3 WORLD WIDE TOTAL ENERGY USE)

3.5.1 Conventional Energy Sources (Non - renewable) :

The energy sources which get exhausted with use and cannot be replaced are called conventional energy sources.

These include

* fossil fuels - petroleum, oil, coal, natural gas
* nuclear energy - uranium, thorium

1. Fossil fuels :

Fossil Fuels include petroleum (liquid), coal (solid) and natural gas (gaseous). About 90% of the world's demands are met by burning Fossil fuels.

Petroleum :

Petroleum is the main element of fossil fuel available in liquid state. It is highly inflamabe. It is formed from the remains of plants and animals, which were buried under sand and mud due to earthquakes. The high pressure and temperature of the earth's crust change these remains to petroleum.

Light fuels contain hydrocarbon chains with atleast 50 carbon atoms while giant molecules up to several hundred carbon atoms constitute heavy fuels and waxes. Different component of the crude oil are separated by fraction distillation.

Gasoline – used in automobiles and airplanes

Diesel – used in automobiles and locomotives

About 70% of these oil are used in power stations in producing steam, lubricating oils, gear oils, greases, etc.

Coal :

This is the most abundant and easily available fossil fuel. It is solid fossil fuel formed by partial decomposition of plants deposited in layers at varying depths. Coal contains water, carbon, sulphur and nitrogen.

3.5.2 Non-conventional energy sources (Renewable) :

1. Nuclear Energy :

A small amount of radioactive material can produce enormous amount of energy. Uranium-235 is the most popular radio active element used for producing nuclear energy.

For example,

1 tonne of Uranium-235 will produce as much as energy as by three million tonnes of coal or 12 million barrels of oil.

Nuclear energy can be released to generate electricity by two nuclear processes :

(i) Nuclear fission

(ii) Nuclear fusion

(i) Nuclear fission :

Inside the nucleus, protons and neutrons are held together by a strong nuclear force of attraction. When an atomic nucleus splits, a tremendous amount of energy is released. This energy is known as nuclear energy or atomic energy. This process of splitting of atoms is called nuclear fission. Nuclear power plants use nuclear fission to produce electricity.

The atom bombs, which were dropped on Hiroshima and Nagasaki of Japan is 1945, are examples of the tremendous power of nuclear energy.

(ii) Nuclear fusion :

It is the process of combining atomic nuclei to form heavier or larger atom, releasing energy.

The sun produces energy by nuclear fusion.

- **Advantages of Nuclear Energy :**
  1. Cost of production per unit of power is much less compared to thermal power production.
  2. Nuclear power plants produce no air pollution or carbon dioxide.
  3. The land required for mining of radioactive fuel, for example, uranium ore, is very little compared to that required for coal mining.
  4. As the heat generation in a nuclear power plant is much more compared to a thermal power plant of comparable size, the potential for power generation increases many fold.

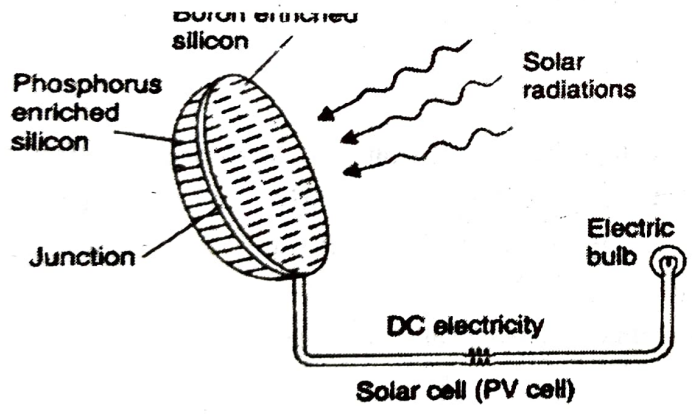
- **Problem related to nuclear Energy :**

(Environmental Impacts of Nuclear Power Plants) :

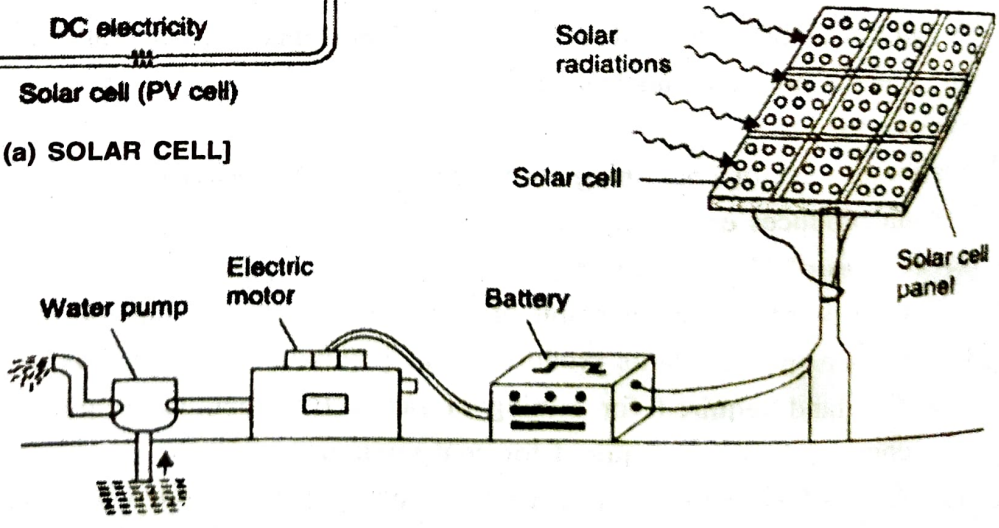
1. The technology required for constructing and operating nuclear power plants are not available in all countries.
2. Waste heat released from nuclear power plants is much more compared to that from a thermal power plant of similar capacity. Hence the potential of thermal pollution increases.
3. Effluents of nuclear power plant may contain radio active waste which is very harmful to living beings.
4. Transport and safety of nuclear fuel is a challanging task.
5. Accident in nuclear power plant may create havoc and affect very large area.
6. Workers involved in the mining and processing of radioactive fuels are at risk of exposing themselves to the ill effects of radiation.
7. Disposal of radioactive waste is an extremely critical step and has to be done with extreme caution.
8. Weapons of mass destruction can be clandestinely built in civilian nuclear power plants by avoiding surveilliance.

2. Solar Energy :

The sun is a source of solar energy. It is a large hydrogen reactor in which continuous nuclear fusion reactions produces enormous amount of energy, in the form of solar radiations. This energy reaches



[FIG. 3.4 (a) SOLAR CELL]



[FIG. 3.4 (b) A SOLAR PUMP RUN BY ELECTRICITY PRODUCED BY SOLAR CELL]

the earth surface as electromagnetic radiations which contains both light and heat energy. The solar energy consists of mainly ultraviolet, visible and infrared radiation. Of course, the harmful ultraviolet radiation is mostly absorbed by the ozonosphere. The visible and infrared radiation reaches the earth as heat radiation.

The sun is 150 million kilometers away from the earth and its rays travel this path and lose most of their energy while travelling. Only 4% of the total solar energy reaches the earth, which is approximately 1 kwh per sq m of flat land on the earth's surface.

Applications (uses) of solar energy :

1. Solar water heating
2. Solar cookers
3. Solar space heating-green houses, homes buildings, etc.
4. Solar drying of agricultural and animal products.
5. Solar distillation - for water purifying.
6. Solar furnaces.
7. Running solar water pump.
8. Photovoltaic cells or solar cells - for electricity in remote areas, power watches, calculators.
9. Traffic signals, street lights, solar lanterns.
10. Solar power plants - to generate electricity.

Advantages of solar energy :

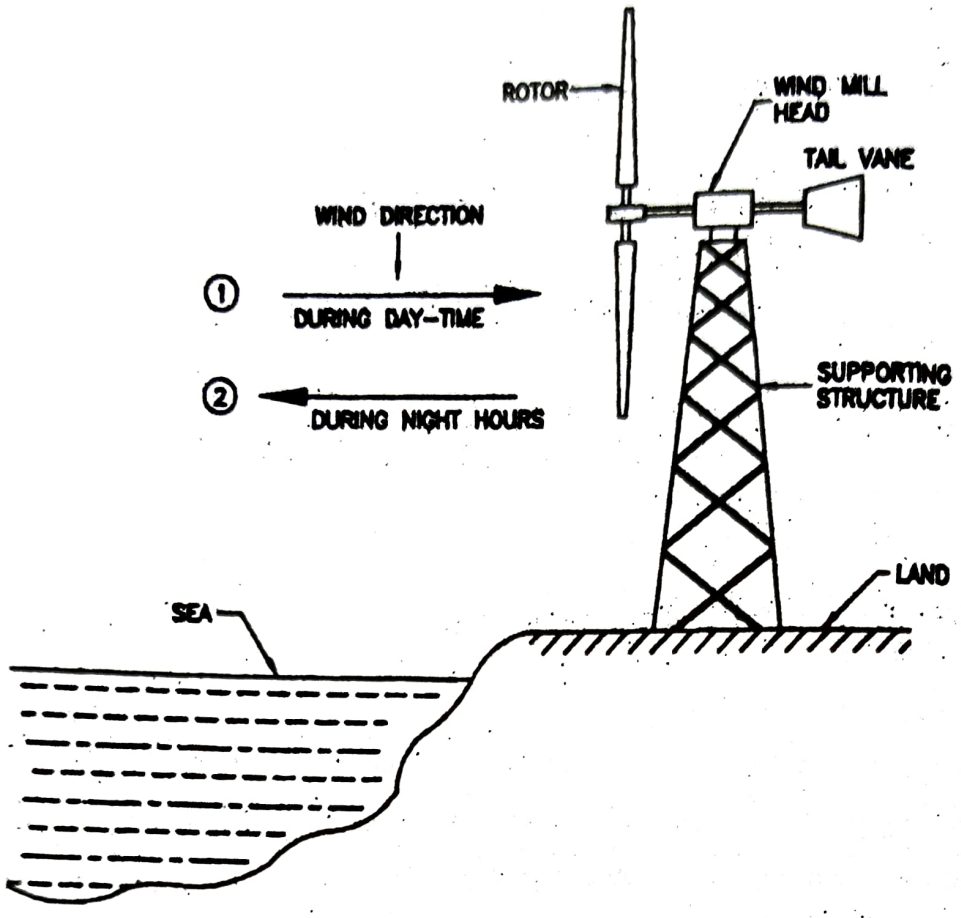
1. Easy installation and maintenance.
2. Free from pollution.
3. Solar energy is also noise free.
4. PV cells (solar cell) are often used in remote locatios that are not connected to the electric grid.
5. Solar energy can be converted to thermal energy and used in many forms.

Limitations of solar energy :

1. Uncertainty of availability of solar energy due to clouds, wind, rainfall, etc.
2. Day and night cycle imposes limitations on continuous collection of solar energy.
3. More surface area is required for collection of solar radiations.
4. Incoming radiation of sun depends upon location and topography of place.
5. Initial cost is higher.
6. Commercially not available.
7. Less acceptibility amongst common people.

Wind energy :

Wind is essentially air in motion. It is caused by the uneven heating of the earth's surface by the The kinetic energy possessed by moving air is proportional to the wind speed.



[FIG. 3.5 WIND GENERATION]

Wind energy can be used for running turbines to generate electricity which can be used for different purposes. Wind energy is cheap and pollution free energy resource. Installation of wind power mills requires such locations where wind speed is more than 6.5 m/sec.

According to the department of Non-conventional Energy sources (DNCES) in India, the total wind energy potential is about 6000 Mw located in Tamilnadu and 5000 Mw located in Gujarat. But India has been able to harness only 2000 Mw.

In Gujarat wind farms have been located at Mandvi-Kutch and Lambha near Dwarka.

- **Applications of wind energy :**
  1. To generate electricity through wind mills.
  2. To run water pumps to supply water for irrigation fields.
  3. To run flour mills for grinding grains.
  4. To run any machine without use of electric power.
- **Advantages of wind energy :**
  1. Completely non-polluting source of energy.
  2. Initial investment is moderate.
  3. Easy and quick construction.
  4. Operation and maintenance costs are smaller.

5. Generation is cheaper.
6. Mostly used in hilly and coastal areas.
7. No raw material is required.
8. Wind energy farms can be installed in a higly decentralized manner.
9. Land below the turbines can be utilized for growing crops and stock grazing.

- **Limitations of wind energy :**

1. Location must have high wind speed (> 6.5 m/sec)
2. Direction of winds are continuously changing.
3. Motion of wind is variable and unsteady.
4. Steady winds are needed. Otherwise the power production rate will not be uniform and sometimes production becomes intermittent.
5 Noise produced by the turbine makes it unsuitable for installation in populated localities/cities.
6. Located only in vast open areas.
7. High wind speed during thunderstorm may seriously damage the system.

4. Hydropower Energy :

The energy in the flowing water can be used to produce electricity. Hydro power can be generated using water collected and stored at high elevation and led through tunnels or pipelines to a turbine generator located at low level. Dam can be created across a river to raise the water level and water stored may be led through tunnels or pipes to the turbine generator. We can also construct mini or micro-hydel power plants on the rivers in hilly regions for harnessing the hydro energy on a small scale, the minimum height of the waterfalls should be 10 meters.

Hydropower does not cause any pollution, it is renewable and normally the hydro power projects are constructed for multiple purpose like providing irrigation, flood control and generation of power.

- **Advantages of Hydropower energy :**

1. Once dam is constructed, the energy is virtually free.
2. Electricity can be generated constantly.
3. Non-polluting and hence environmental friendly.
4. Cost of power generation is low.
5. Can be started very quickly and stopped also.
6. Much more reliable than wind, solar or wave power.
7. Saves scarce fuel reserves.
8. Reservoir of dam can be multipurpose i.e. irrigation, domestic water supply, fishing, navigation etc.

- **Limitations and problems of Hydropower energy :**
  (disadvantages of large dams) :

1. The dams are very expensive to build.
2. Reservoir submerges large area, creating problems of rehabilitation of humans and wild life.
3. Deforestation due to large area of submergence.
4. Environmental aspect accounts for the main bottleneck in project approval. It takes 2 to 5 years to get forest and environment clearance.

5. Projects suffer from lots of political and social hurdles.
6. Weight of water stored in the reservoir can increase the seismic activity in the area.
7. The site becomes a target of attack during war.

5. Geothermal energy :

Geothermal energy means heat from the earth. The earth's core, with temperatures as high as 60000 °C, is a molten mass of material possessing vast amount of energy. High temperature and high pressure steam fields exist below the earth's surface in many places. In some regions, this material sometimes breaks through the earth and produces volcanoes. In other regions, the hot material is close enough to the surface to heat underground water and form steam. Geysers and hot springs are natural areas where this steam and hot water come to the surface. In areas, where the steam is trapped underground, geothermal energy is tapped by drilling wells to obtain the steam. The steam is then used to power electrical generators. At present geothermal energy is practical only in areas where this hot mass is near the surface.

The main sources of this energy is the decay of radioactive Uranium, Thorium and radioactive isotope of potassium i.e. 40.

Hot water from the geothermal energy resources (well) at Chumathang (Laddakh) is used to heat the soil and environment of a green house supporting the growth of above 40 varieties of plants even at the peak of winter. 340 Thermal areas represented by hot springs are known in India. Regions where research is being undertaken include geothermal fields at Manikaran, Kasol (H.P.), Sona (Haryana), Puga and Chumathang (Laddakh) etc.

In India, Northwestern Himalayas and the western coast are considered geothermal areas. Satellities like the IRS-1 have played an important role, through infrared photographs of the ground, in locating geothermal areas. The Puga valley in the Laddakh region has the most promising geothermal field. An experimental 1 kw generator is already in operation in this area. It is being used mainly for poultry farming, mushroom cultivation and pashminawool processing, all of which need higher temperature.

3.6 CONSERVATION OF NATURAL RESOURCES :

Conservation of natural resources means sustainable use of natural resources. It is derived from two latin words,

'con' means together

'servare' means to guard or to keep.

Thus, conservation means **"to keep together".**

Natural resources like wind, water, forests, etc. existed on earth much before man came into being. But, excessive and umplanned use of these resources has depleted these resources so much that there is an urgent need for their conservation. The main objectives of the conservation of natural resources are :

(i) To preserve the quality of environment.

(ii) To ensure continuous and balanced cycle of harvest and renewal.

A conservationist has two folds baste aims (i) to insure the preservation of a quality environment that considers aesthetic and recreational as well as product needs and (ii) to insure a continuous yield of useful plants, animals, and materials by establishing a balanced cycle of harvest and renewal (Odum, 1971). Thus, conservation process remains chiefly concerned with the use, preservation and proper management of the natural resources of the earth and their protection from the destructive influences, misuse, decay, fire, or waste.

The natural resources include all the land, minerals, water, vegetation, wild-life and sceneries, all of which remain useful to human society in one way or other. Customarily, natural resources are classified into following three categories:

(i) Non-renewable resources like metals (iron, copper, zinc, etc.), fossil fuels (coal and oil deposits), other minerals and their salts (phosphates, nitrates, carbonates, and stone.

(ii) Renewable resources such as living resources like fish, forests, crops, wood, etc.

(iii) Unalterable resources - the resources that are used outside the human body the gathering of which leaves they unaltered.

There are some example of conservation of natural resources :

(i) Prevention of Soil Erosion :

(a) Trees should not be cut down unless absolutely necessary. Only a few trees should be cut down at one time and whenever possible trees should be planted (afforestation). Plants like bamboos and other suitable species should be planted. These plants help as soil binders by not allowing top soil to run down with the flow of water. The roots of these plants hold the soil firmly together.

(b) Trees should be planted in rows. Trees planted in rows act as wind-breakers. They break the force and speed of a strong wind and prevent it from carrying away the fertile top soil and help to prevent wind erosion.

(c) In agricultural fields, there should be proper irrigation and drainage system so that top soil is not washed away with the flow of water.

(d) On slope of hills, contour-farming or terrace-farming should be practiced to prevent direct loss of top soil, due to water running down the slopes.

(e) Agricultural land should not be left unused for a long time to prevent wind erosion. Cultivation of crops should be a regular feature.

(ii) Prevention of Water Pollution :

(a) Industrialists should be advised not to empty their industrial wastes directly into lakes and rivers. If at all the waste is to be poured into running waters or lakes, the waste material should be treated and filtered out.

(b) Ship and oil tankers should not dump their oil in the oceans.

(c) The organic wastes from cities (sewage) should not be allowed to pollute the surrounding water. Special sewage plants should be made to bring about oxidation of sewage. Finally, the water free of sewage should be released into rivers or lakes.

(iii) Conservation of Non-Renewable Natural Resources :

Since non-renewable resources cannot be replaced once they are exhausted, we should use these as sparingly as possible. Among these the important ones are minerals, coal and oil. Alternatively, we should search for such sources of power generation which will not be exhausted i.e. wind and solar energy.Industries which recover and recycle waste materials should be encouraged because they play a major role in conserving natural resources. Wasteful use of resources should be discouraged.

After recognizing the impact of human interference causing changes in the environment, every citizen should try to conserve the natural resources and the natural environment. Only then can man hope to lead heal their life in future.

: MULTIPLE CHOICE QUESTIONS :

Q. 1 MCQs :

1. Removal of surface soil due to rain is known as .....

(a) Soil conversation (c) soil erosion

(b) Soil renovation (d) all of the above

2. Sardar Sarovar dam is situated on ..... river

(a) Narmada (b) tapi (c) mahi (d) Bhagirathi

3. ..... reduces noise and environment pollution

(a) forest (b) land (c) water (d) sun

4. Desert throny forest is found in .....

(a) anand (b) saurastra (c) valsad (d) none of these

5. ..... is a renewable resources.

(a) coal (b) oil (c) water (d) petrol

6. vehical release ..... in atmosphere.

(a) oxygen (b) carbon dioxaide (c) hydrogen (d) all of these

7. solar energy is ..... in nature.

(a) renewable (b) non renewable (c) man made (d) non of these

8. ..... are causes of deforestation .

(a) soil pollution (b) soil erosion (c) water logging (d) pollution explosion

9. What is water underground called?

(a) aquatic water (b) terrestrial water (c) ground water (d) none

10. ..... is considered the greatest among natural resources

(a) land (b) Water (c) forest (d) Mineral

11. Forest is

(a) in exhaustible (b) exhaustible (c) abiotic (d) Man made

12. Overuse of chemical fertilisers makes the land

(a) fertile (b) Productive (c) Unproductive (d) None

13. Which one of the following is not a cause for deforestation?

(a) fire (b) overgrazing (c) urbanization (d) Navigation

14. Dam construction causes

(a) disruption of fishing and waterway traffic (b) misuse and wastage of water

(c) drying out of wetlands (d) Enrichment of soil

15. ..... reduces noise and environmental pollution

(a) forest (b) Land (c) Water (d) Sun

: SHORT QUESTIONS :

Q. 2 Short questions :

1. Explains the terms renwable and non rewable natural resources
2. Write any 2 features of land management
3. Write about the different water resources.
4. What is drought ?
5. Write the advantage of dam
6. Define conservation.
7. Enlist on 4 types of forest in Gujarat.
8. Write the effect of deforestation
9. Give the name of any 2 renwable natural resources
10. Define soil erosion & conservation
11. Name various methods of soil conservation.
12. What are the effects of deforestation?
13. What are resources?
14. What is Reforestation?
15. Enlist any 4 types of forest in Gujarat.

: LONG QUESTIONS :

Q. 3 Long questions :

1. Write about the forest type of Gujarat.
2. Explain the conversation of natural resources.
3. Write about the classification of natural resources
4. Explain conversation strategies of forest resources
5. What are natural resources ? describe in detail.
6. Uses of forest to human society.
7. Uses and conservation of land resources .
8. Write the major causes of deforestation
9. Give an account of renewable and non renewable natural resources.
10. Write the conservation strategies of forest
11. Discuss the benefits and adverse effects of dams.
12. Give a detailed account on plant species composition in Gujarat.
13. Write a note on Conservation strategies of Forests.
14. What are the problems and benefits of Dams?
15. Write notes on Conservation of water.

❀❀❀