Unit III

1.5 NATURAL RESOURCES

Natural resources (economically referred to as land or raw materials) occur naturally within environments that exist relatively undisturbed by mankind, in a natural form.

1.5.1 FOREST RESOURCES

1.5.1.1Commercial uses

Man depends heavily on a larger number of plant and animal products from forests for his daily needs.
The chief product that forests supply is wood, which is used as fuel, raw material for various industries as pulp, paper, newsprint, board, timber for furniture items, other uses as in packing articles, matches, sports goods etc.
Indian forests also supply minor products like gums, resins, dyes, tannins, fibers, etc.
Many of the plants are utilized in preparing medicines and drugs; Total worth of which is estimated to be more than $300 billion per year.
Many forests lands are used for mining, agriculture, grazing, and recreation and for development of dams.
Depending upon the climate conditions, forest may be classified as:

Tropical Rain Forests: They are evergreen broadleaf forests found near the equator. They are characterized by high temperature, high humidity and high rainfall, all of which favor the growth of trees.
Tropical deciduous forests: They are found a little away from the equator and are characterized by a warm climate the year round. Rain occurs only during monsoon.
Tropical scrub forests: They are found in areas where the day season is even longer.
Temperate rain forests: They are found in temperate areas with adequate rainfall. These are dominated by trees like pines, firs, redwoods etc.
Temperate deciduous forests: They are found in areas with moderate temperatures.
Evergreen coniferous forests (Boreal Forests): They are found just south of arctic tundra. Here winters are long, cold and dry. Sunlight is available for a few hours only.

1.5.1.2 Ecological uses

The ecological services provided by our forests may be summed up as follows:

Production of Oxygen: The main green house gas carbon dioxide is absorbed by the forests as a raw material for photo synthesis. Thus forest canopy acts as a sink for carbon dioxide thereby reducing the problem of global warming caused by green house gas CO_2
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. They control climate through transpiration of water and seed clouding.

Soil Conservation: Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as wind breakers.
Pollution moderators: Forests can absorb many toxic gases and can help in keeping the air pure and in preventing noise pollution.

1.5.2 over Exploitation of Forests

Man depends 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.
The devasting effects of deforestation in India include soil, water and wind erosion, estimated to cost over 16,400 cores every year.

1.5.3 Deforestation

Deforestation means destruction of forests.
The total forests area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.
Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.
Deforestation is a continuous process in India where about 1.3 hectares of forest land has been lost.
The per capita availability of forest in India is 0.08 hectares per person which is much lower than the world average of 0.8 hectares.
The presence of waste land is a sign of deforestation in India.

1.5.3.1 Causes of Deforestation

Major causes of deforestation are listed below:
Development projects
Shifting cultivation
Fuel requirements cutting and burning
Construction of dams

Growing food needs.

1.5.3.2 Consequences of deforestation

Some of the effects of deforestation are listed below:

a) Effect on climate

Global warming
Less rainfall
Hot climate.

b) Effect on biodiversity

Loss of medicinal plants.
Loss of timber, fuel wood.

c) Effect on resources

Loss of land resource
Loss of soil fertility
Soil erosion
Drastic changes in biogeochemical cycles

d) Effect on economy

Increase in medicinal values
Demand of industrial products.

e) Effect on food

Loss of fruit production
Loss of root based foods.

1.5.4 Case Studies

Desertification in hilly regions of the Himalayas:

Desertification in Himalayas, involving clearance of natural forests and plantation of monocultures like Pinus roxburghi, Eucalyptus camadulensis etc., have upset the ecosystem by changing various soil and biological properties.

The area is invaded by exotic weeds. These areas are not able to recover and are losing their fertility.

1.5.4.1 Disappearing Tea gardens in Chhota Nagpur

Following the destruction of forest rain fall declined in Chhota Nagpur to such an extent that tea-gardens also disappeared from the region.

Waning rain fall in Udhagamandalam

The rainfall pattern was found to fluctuate with wooded land area in the hills. When the Nilgiri mountains had luxuriant forest cover annual rainfall used to be much higher.

1.6 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.
In India, firewood demand would continue to rise in future mostly consumed in rural areas, where alternative sources of energy, are yet to reach.

1.7 MINING

Mining is the process of removing deposits of ores from substantially very well below the ground level.
Mining is carried out to remove several minerals including coal.
These mineral deposits invariably found in the forest region, and any operation of mining will naturally affect the forests.
Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining.
More than 80,000 ha of land of the country are presently under the stress of mining activities.

1.7.1 Effects of mining resources

Mining operation require removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
Large scale of deforestation has been reported in Mussorie and Dehradun valley due to mining of various areas.
Indiscriminate mining in Goa since 1961 has destroyed more than 50,000 ha of forest land.
Mining of radioactive mineral in Kerala, Tamilnadu and Karnataka are posing similar threats of deforestation.

1.8 DAMS AND THEIR EFFECTS ON FORESTS AND TRIBAL PEOPLE

Big dams and river valley projects have multi-purpose uses and have been referred to as "Temples of modern India".
India has more than 1550 large dams, the maximum being in the state of Maharashtra (more than 600) followed by Gujarat (more than 250) and Madhya Pradesh (130).
The highest one is Tehri dam, on river Bhagirathi in Uttaranchal and the largest in terms of capacity is Bhakra dam on river Sutlej.

1.8.1 Effects on Tribal people

The greatest social cost of big dam is the widespread displacement of local people.
It is estimated that the number of people affected directly or indirectly by all big irrigation projects in India over the past 50 years can be as high as 20 millions.
The Hirakud dam, one of the largest dams executed in fifties, has displaced more than 20,000 people residing in 250 villages.

1.8.2 Effects on forests

Thousands of hectares of forests have been cleared for executing river valley projects which breaks the natural ecological balance of the region. Floods, landslides become more prevalent in such areas.
Eg:
The Narmada sagar project alone has submerged 3.5 lakh hectares of best forest comprising of rich teak and bamboo forests.
The Tehri dam submerged 1000 hectares of forest affecting about 430 species of plants according to the survey carried out by the botanical survey of India.

1.9 WATER RESOURCES

Water is an important component of all living beings. Nearly 80% of earth's surface is covered by water.

1.9.1 Uses of Water

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 contained in the body.
Uptake of nutrients, their distribution in the body, regulation of temperature, and removal of wastes are all mediated through water.
Human beings depend on water for almost every developmental activity.
Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal power plants.
Water shaped the earth's surface and regulates our climate.

1.9.2 Hydrological cycle

1. Evaporation
2. Precipitation
3. Transpiration

Evaporation

The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere. The source of energy for evaporation is primarily **solar radiation.** Evaporation often implicitly includes **transpiration** from plants, though together they are specifically referred to as **evapotranspiration**. Total annual evaporation amounts to approximately 505,000 km^3 (121,000 cu mi) of water, 434,000 km^3 (104,000 cu mi) of which evaporates from the oceans.

Precipitation

Condensed water vapor that falls to the Earth's surface .Most precipitation occurs as rain, but also includes snow, hail, fog drip, graupel, and sleet. Approximately 505,000 km^3 (121,000 cu mi) of water falls as precipitation each year, 398,000 km^3 (95,000 cu mi) of it over the oceans.

Condensation

The transformation of water vapor to liquid water droplets in the air, creating clouds and fog.

Transpiration
The release of water vapor from plants and soil into the air. Water vapor is a gas that cannot be seen.
Snowmelt
The runoff produced by melting snow.
Runoff
The variety of ways by which water moves across the land. This includes both surface runoff and channel runoff. As it flows, the water may seep into the ground, evaporate into the air, become stored in lakes or reservoirs, or be extracted for agricultural or other human uses.
Infiltration
The flow of water from the ground surface into the ground. Once infiltrated, the water becomes soil moisture or groundwater.
Subsurface Flow
The flow of water underground, in the vadose zone and aquifers. Subsurface water may return to the surface (e.g. as a spring or by being pumped) or eventually seep into the oceans. Water returns to the land surface at lower elevation than where it infiltrated, under the force of gravity or gravity induced pressures. Groundwater tends to move slowly, and is replenished slowly, so it can remain in aquifers for thousands of years.
Sublimation
The state change directly from solid water (snow or ice) to water vapor.

Flow chart

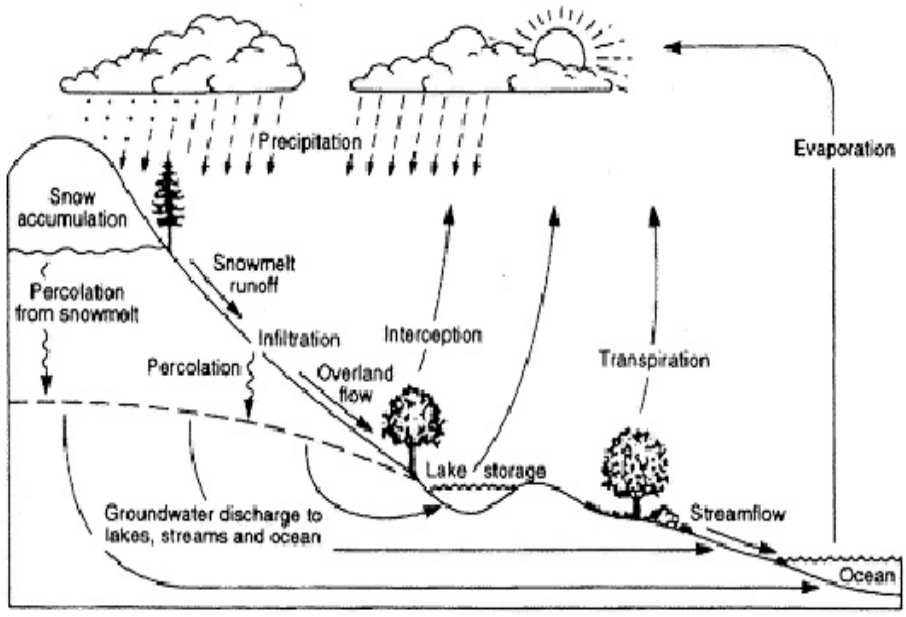

Fig.1.1 Water Cycle

1.10 OVER UTILIZATION OF SURFACE AND GROUND WATER

With increasing human population and rapid development, the world water withdrawal demands have increased many folds and a large proportion of the water withdrawn is polluted due to anthropogenic activities.
Out of the total water reserves of the world, about 97% is salty water and only 3% is fresh water. Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water.

1.10.1 Effects of over exploitation of water

Subsidence: When ground water withdrawal is more than its recharge rate, the sediments in the aquifer (a layer of rock that is highly permeable and contains water) get compacted, a phenomenon knows as ground subsidence. It results in sinking of overlying land surface. Due to this structural damage in buildings, fracture in pipes etc., occurs.
Lowering of water table: Mining of groundwater is done extensively for irrigating crop fields. However, excessive mining would cause lowering of water table.
Water logging: When excessive irrigation is done with brackish water it raises the water table gradually leading to water-logging and salinity problems.

1.11 FLOODS AND DROUGHT

Heavy rainfall often causes floods in the low-lying coastal areas.
Prolonged downpour can also cause the over-flowing of lakes and rivers resulting into floods.
When annual rainfall is below normal and less than evaporation, drought conditions are created.

Fig.1.2 Drought

1.11.1 Causes of flood and drought

Deforestation, overgrazing, mining, rapid industrialization, global warming etc., have contributed largely to a sharp rise in the incidence of floods.
Deforestation leads to desertification and drought too. When the trees are cut, the soil is subject to erosion by heavy rains, winds and sun.
The removal of thin top layer of soil takes away the nutrients and the soil becomes useless.
The eroded soils exhibit droughty tendency.

1.11.2 Preventive measures

Clear knowledge in control of drought and desertification can be very useful for dealing with the problem.
Carefully selected mixed cropping helps to optimize production and minimize the risks of crop failures.
Social forestry and Wasteland development can prove quite effective to fight the problem, but it should be based on proper understanding of ecological requirement and natural process.

1.12 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. Many countries are engaged in bitter rivalries over this precious resource.
For instance,
Argentina and Brazil, dispute each other's claims to the La Plata river,
India and Pakistan fight over the rights to water from the Indus,
Mexico and USA have come in conflict over the Colorado river,
India and Bangladesh are fighting for Bhrahmaputra river, and
Iran and Iraq contest for the water from Shatt-Al- Arab River.

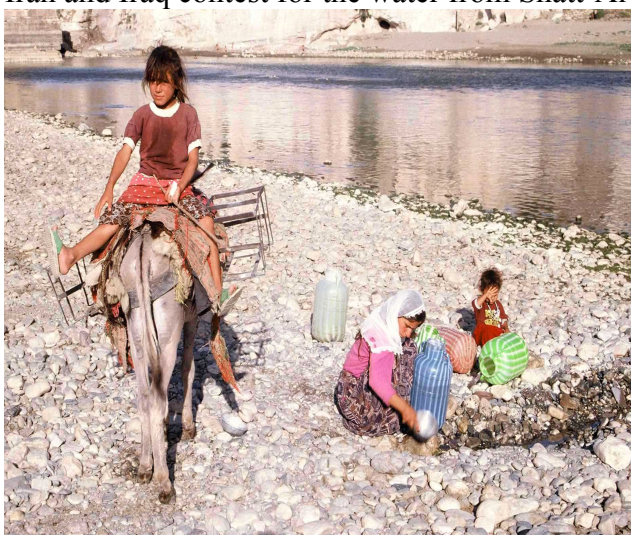

Fig.1.3 Conflicts of water

Within India, water conflicts are still being continues between the states.
For Eg.,
Sharing of Krishna water between Karnataka and Andhra Pradesh,
Sharing of Siruvani water between Tamilnadu and Kerala, and others.
Sharing of Cauvery between Karnataka and Tamilnadu
On June 2,1990, the Cauvery Water dispute Tribunal was set up which through an interim award directed Karnataka to ensure that 205 TMCF of water was made available in Tamil Nadu's Mettur dam every year, till a settlement was reached.

In 1991-1992 due to good monsoon, there was no dispute. In 1995, the situation turned into a crisis due to delayed rains and an expert Committee was set up to look into the matter which found that there was a complex cropping pattern in Cauvery basin.
Samba paddy in winter, Kuravai paddy in summer and some cash crops demanded intensive water; thus aggravating the water crisis.
Proper selection of crop varieties, optimum use of water, better rationing are suggested as some measures to solve the problem

1.13 BIG-DAMS –BENEFITS AND PROBLEMS

Dams are built across the river in order to store water for drinking, agricultural, industrial purpose. Now days they are mainly used for the hydropower production.

1.13.1 Benefits

River valley projects with big dams play a key role in the development process due to their multiple uses.
These dams aim at providing employment for tribal people and raising the standard and quality of life.
Dams can help in checking floods and generate electricity and reduce water and power shortage, provide irrigation water to lower areas, provide drinking water in remote areas and promote navigation, fishery.

1.13.2 Problems

The impacts of big dams can be upstream as well as downstream levels. The upstream problems include the following:
Displacement of tribal people
Loss of forests, flora and fauna
Changes in fisheries
Saltation and sedimentation of reservoirs
Loss of non-forest land
Stagnation and water logging near reservoir
Breeding vectors and spread of vector –borne diseases
Reservoir induces seismicity causing earthquakes
Microclimatic changes
Growth of aquatic weeds

1.13.3 Downstream problems include the following

Water logging and salinity due to over irrigation
Microclimatic changes
Reduced water flow and slit deposition in river
Flash foods
Salt water intrusion at river mouth
Loss of land fertility
Outbreak of vector-borne diseases like malaria.

1.14 MINERAL RESOURCES

Minerals are naturally occurring substances with definite chemical and physical properties.

1.14.1 Uses of minerals

Mineral is an element or inorganic compound that occurs naturally. The main uses of minerals are as follows:
Development of industrial plants and machinery
Generation of energy e.g. coal, lignite, uranium
Construction, housing, settlements
Defense equipments- weapons, settlement
Transportation
Communication-telephone wires, cables, electronic devices
Medical system- particularly in Ayurvedic System
Formation of alloys for various purposes
Agriculture- as fertilizers, seed dressings and fungicides
Jewellery- e.g. Gold, silver, platinum, diamond

Table 1.1 Distribution and uses of major reserves and metals

Metals	**Major world reserves**	**Major uses**
Aluminum	Australia, Jamaica	Packing food items, transportation, utensils, electronics
Chromium	CIS(The common wealth of Independent states), South Africa	For making high strength steel alloys, in textiles and tanning industries
Copper	U.S.A, Canada, CIS	Electronic and electrical goods, building, construction, vessels
Iron	CIS, Canada, U.S.A	Heavy machinery, steel production transportation means.
Manganese	South Africa, CIS	For making high strength heat resistant steel alloys
Platinum	South Africa, CIS	Use in automobiles, catalytic converters, electronics, medical uses.
Gold	South Africa, CIS, Canada	Ornaments, medical use, electronic use, in aerospace
Silver	Canada, South Africa	Photography, electronic jewellery.
Nickel	CIS, Canada	Chemical industry, steel alloys

Table 1.2 Major uses of some of the non metallic minerals

Non-metal mineral	**Major uses**
Silicate minerals	Sand and grovel for construction, bricks, paving etc.
Limestone	Used for concrete, building stone, used in agriculture for neutralizing acid soils, used in cement industry
Gypsum	Used in plaster wall-board, in agriculture
Potash, phosphorite	Used as fertilizers

Sulphur pyrites	Used in medicine, car battery, industry

1.14.2 Environmental impacts of mineral extraction

Major mines which are known for causing severe problems are given below:
Jaduguda Uranium Mine, Jharkhand- exposing local people to radioactive hazards.
Jharia coal mines, Jharkhand- underground fire leading to land subsidence and forced displacement of people.
Sukinda chromite mines, Orissa- Seeping of hexavalent chromium into river posing serious health hazard, Cr^{6+} being highly toxic and carcinogenic.
Kudremukh iron ore mine, Karnataka- causing river pollution and threat to biodiversity.
East coast Bauxite mine, Orissa-Land encroachment and issue of rehabilitation unsettled.
North-Eastern Coal Fields, Assam-Very high sulphur contamination of groundwater.

1.14.3 Impacts of mining: Mining is done to extract minerals from deep deposits in soil. Environmental damages caused by mining activities are as follows:

Devegetation and defacing of lands: Mining requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
Subsidence of land: Subsidence of mining areas results in tilting of buildings, cracks in houses, buckling of roads, bending of rail tracks and leaking of gas from cracked pipe lines leading to serious disasters.
Groundwater contamination: Mining pollutes the groundwater. Sulphur, usually present as an impurity in many ores is known to get converted into sulphuric acid through microbial action, thereby making the water acidic.
Surface water pollution: The acid mine drainage often contaminates the nearby streams and lakes. The acidic water, radioactive substances like uranium, heavy metals also contaminate the water bodies and kill aquatic animals.
Air pollution: In order to separate and purify the metal from other impurities in the ore, smelting is done which emits enormous quantities of air pollutants. Oxides of sulphur, arsenic, cadmium and lead etc. shoot up in the atmosphere near the smelters and the public suffers from several health problems.
Occupational Health Hazards: Miners working in different type of mines suffer from asbestosis, silicosis, black lung disease.

1.14.4 Remedial measures

Adopting eco-friendly mining technology
Utilization of low grade ores by using microbial – leaching technique. In this method, the ores are inoculated with the desired strains of bacteria like Thiobacillus ferroxidans, which remove the impurities and leave the pure mineral.
Re-vegetating mined areas with appropriate plants
Gradual restoration of flora
Prevention of toxic drainage discharge.

1.14.5 Case studies

1. Mining and quarrying in Udaipur

Soap stones, building stone, and dolomite mines spread over 15,000 hectares in Udaipur have caused many adverse impacts on environment.
About 150 tons of explosives are used per month in blasting.
The Maton mines have badly polluted the Ahar river.
The hills around the mines are suffering from acute soil erosion.
The waste water flows towards a big tank of “Bag Dara".
Due to scarcity of water people are compelled to use this effluent for irrigation purpose.
The animals like tiger, lion, deer, and birds have disappeared from the mining area.

2. Mining in Sariska and Tiger Reserve in Aravallis

The Aravalli range is spread over about 692 Km in the North-west India covering Gujrat, Rajasthan, Haryana, and Delhi.
The hill is rich in mineral resources.
Mining operations within and around the Sariska Tiger reserve has left many areas permanently infertile and barren.
The precious wild life is under serious threat.

1.15 FOOD RESOURCES

1.15.1 World Food Problems

During the last 50 years world grain production has increased almost three times.
The per capita production is increased by about 50%.
At the same time population growth increased at such a rate in less developed countries.
Every 40 million people die of undernourishment and malnutrition.
This means that every year our food problem is killing as many people as were killed by the atomic bomb dropped on Hiroshima during World War II.
This statistics emphasize the need to increase our food production, and also to control population growth.
It is estimated that 300 millions are still undernourished.

1.15.2 Impacts of overgrazing and agriculture

1.15.2.1 Overgrazing

Overgrazing can limit livestock production. Over grazing occurs when too many animals graze for too long and exceed the carrying capacity of a grass land area.

Impact of overgrazing

Land degradation: Overgrazing removes the grass cover. The humus content of the soil is decreased and it leads to poor, dry, compacted soil.
Soil erosion: The soil roots are very good binders of soil. When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.

Loss of useful species: Due to overgrazing the nutritious species like cenchrus, panicum etc. are replaced by thorny plants like Parthenium, Xanthium etc. These species do not have a good capacity of binding the soil particles and, therefore, the soil becomes more prone to soil erosion.

1.15.2.2 Agriculture

Traditional Agriculture and its impacts
Usually involves a small plot
Simple tools
Naturally available water
Organic fertilizer and a mix of crops

1.15.2.3 Main impacts

Deforestation
Soil erosion
Depletion of nutrients

1.15.2.4 Modern Agriculture and its impacts

It makes use of hybrid seeds of selected and single crop variety.
High-tech equipments, lots of energy subsidies in the form of fertilizers and, pesticides
Irrigation water

1.15.2.5 Main impacts

Impacts related to high yielding verities (HYV): The uses of HYVs encourage monoculture i.e. the same genotype is grown over vast areas. In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of the disease.

1.15.3 Fertilizer related problems

Micronutrient imbalance: Chemical fertilizers have nitrogen, phosphorus and potassium (N, P and K) which are essential macronutrients. Excessive use of fertilizers cause micronutrient imbalance. For example, excessive fertilizer use in Punjab and Haryana has caused deficiency of the micronutrient Zinc in the soils, which is affecting productivity of the soil.
Nitrate Pollution: Nitrogenous fertilizers applied in the fields often leach deep into the soil and ultimately contaminate the ground water. The nitrates get concentrated in the water and when their concentration exceeds 25 mg/L, they become the cause of a serious health hazard called "**Blue Baby Syndrome**" or methaemoglobinemia. This disease affects the infants to the maximum extent causing even death.


Fig.1.4 Blue baby syndrome

Eutrophication: A large proportion of nitrogen and phosphorus used in crop fields is washed off along with runoff water and reach the water bodies causing over nourishment of the lakes, a process known as **Eutrophication.** (Eu=more, tropic=nutrition). Due to Eutrophication the lakes get invaded by algal blooms. These algal species grow very fast by rapidly using up the nutrients. The algal species quickly complete their life cycle and die thereby adding a lot of dead matter. The fishes are also killed and there is lot of dead matter that starts getting decomposed. Oxygen is consumed in the process of decomposition and very soon the water gets depleted of dissolved oxygen. This further affects aquatic fauna and ultimately anaerobic conditions are created where only pathogenic anaerobic bacteria can survive. Thus, due to excessive use of fertilizers in the agricultural fields the lake ecosystem gets degraded.

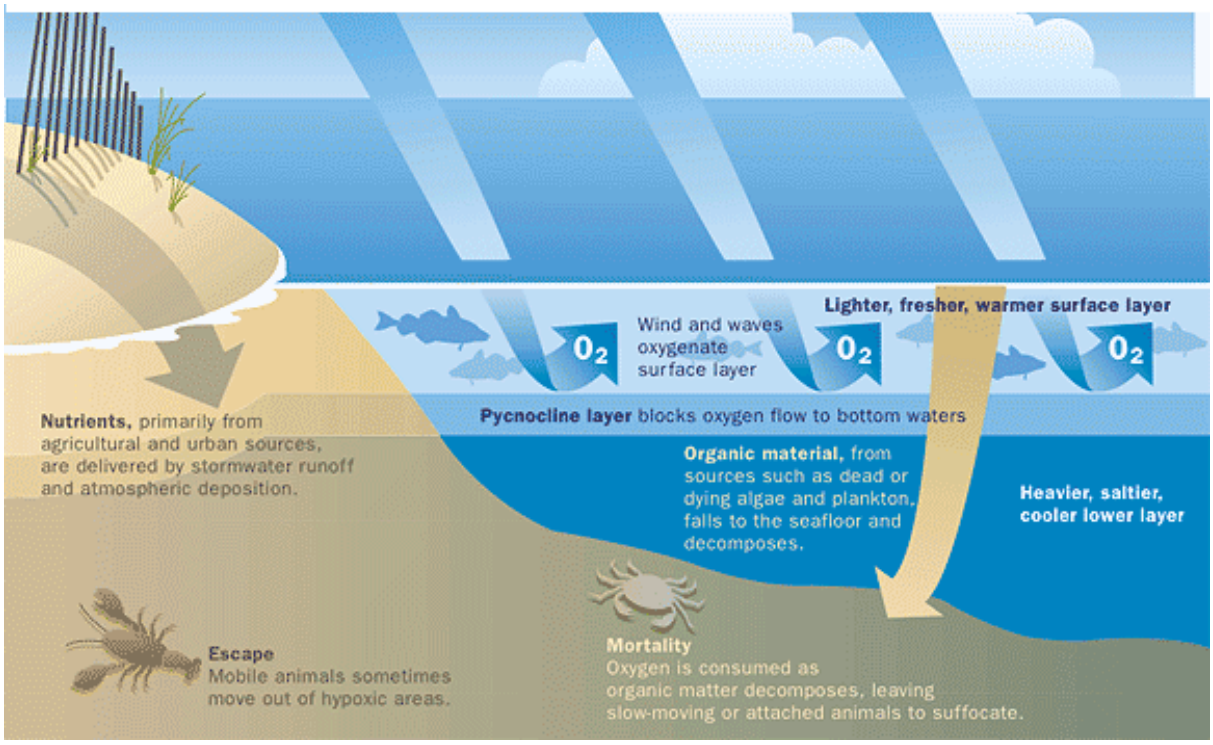

Fig.1.5 Eutrophication

Pesticide related problems: Thousands of types of pesticides are used in agriculture. The first generation pesticides include chemicals like sulphur, arsenic, lead or mercury to kill the pests. They have number of side effects as discussed below:
Creating resistance in pests and producing new pests: About 20 species of pests are now known which have become immune to all types of pesticides and are known as "Super pests".
Death of non-target organisms: Many insecticides not only kill the target species but also several non-target species that are useful to us.
Biological magnification: Many of the pesticides are non-biodegradable and keep on accumulating in the food chain, a process called biological magnification. This is very harmful.

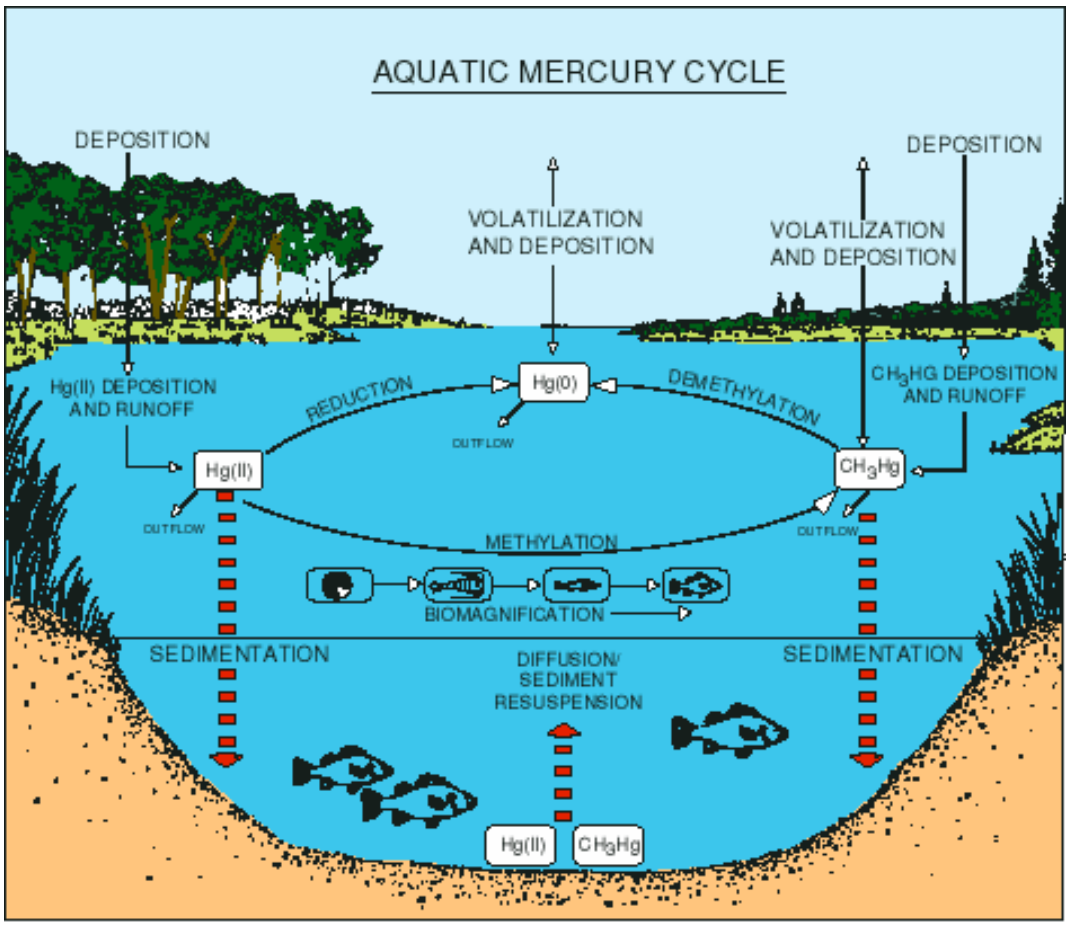

Fig.1.6 Biomagnification

Water Logging: Over irrigation of croplands by farmers for good growth of their crop usually leads to water logging. Inadequate drainage caused excess water to accumulate underground and gradually forms a continuous column with the water table. Under water-logged conditions, pore-spaces in the soil get fully drenched with water and the soil- air gets depleted. The water table rises while the roots of plants do not get adequate air for respiration, Mechanical strength of the soil declines, the crop plants get lodged and crop yield falls. In Punjab and Haryana, extensive areas have become water-logged due to adequate canal water supply or tube-well water. Preventing excessive irrigation, sub-surface drainage technology and bio-drainage with trees like Eucalyptus are some of the remedial measures to prevent water-logging.

Salinity Problem: At present one third of the total cultivable land area of the world is affected by salts. Saline soils are characterized by the accumulation of soluble salts like sodium chloride, sodium sulphate, calcium chloride, magnesium chloride etc. in the soil profile. Their electrical conductivity is more than 4 ds/m. So dic soils have carbonates and bicarbonates of sodium, the pH usually exceed 8.0 and the exchangeable sodium percentage (ESP) is more than 15%.

1.15.3.1 Remedy

(i) The most common method for getting rid of salts is to flush them out by applying more good quality water to such soils.

(ii) Another method is laying underground network of perforated drainage pipes for flushing out the salts slowly.

1.15.4 Case studies

Salinity and water logging in Punjab, Haryana and Rajasthan:
The first alarming report of salt-affected wasteland formation due to irrigation practices came from Haryana in 1858.
Several villages in Panipat, and Delhi lying in Western Yamuna Canal were suffering from salinity problems.
The floods of 1947, 1950, 1952, 1954-55 in Punjab resulted in aggravated water logging with serious drainage problems.
Introduction to canal irrigation in 1.3 m ha in Haryana resulted in raise in water table followed by water-logging and salinity in many irrigated areas as a result of fall in crop productivity.
Rajasthan too has suffered badly in this regard following the biggest irrigation project "Indhra Gandhi Canal Project".

1.16 ENERGY RESOURCES

1.16.1 Definition

Energy may be defined as, “any property, which can be converted into work.” (or)
Energy is defined as, “the capacity to do work.”

Forms of energy, some of immediately used to do work; others require some process of transformation
Life is unthinkable without energy.
All the developmental activities in the world are directly or indirectly dependent upon energy.
Energy production and energy utilization are the indicators of a country’s progress.

1.16.2 Development of energy

The first form of energy is the fire.
The early man discovered fire and used it for cooking and heating purposes
Wood is the main source of energy, which is later replaced by coal.
Coal is now being replaced by the oil and gas.
Now due to insufficient availability and price hike, people started of thinking and using several alternative sources of energy.

Wood→coal→oil→alternate energy (solar, wind, tidal energy)

1.16.3 Growing energy Needs

Energy is essential to all human societies.
All industrial process like, mining, transport, living, heating and cooling in buildings, all require energy.
With the demands of growing population, the world is facing further energy deficit,
Our life style is also changing from al simple way of life to luxurious life style. At present 95% of the commercial energy is available only from the fossil fuels like coal, oil and natural gas, and are not going to last for many years. It would be really ironic if fuel becomes more expensive than food.

1.16.4 Energy Distribution –World Scenario

U.S.A and Canada 5% of the world's population- consume 25% of the available world's energy resources.
It has been observed, that in U.S.A and Canada an average person consumes 300 GJ (Giga Joules; equal to 60 barrels of oil) per year.
But in poor countries like Bhutan, Nepal and Ethiopia, an average person consumes less than 1 GJ per year.
So a person in a developed country consumes almost as much energy in a single day as one person consumes in a whole year in a poor country.
From the above scenario it is clear that our life style and standard of living are closely related to energy needs.

1. Renewable energy resources (or) non-conventional energy resources

Natural resources can be regenerated continuously and are inexhaustible. They can be used again and again in an endless manner.
Example: Wood, solar energy, wind energy, hydropower energy, etc.,

Merits of renewable energy resources

1. Unlimited supply.
2. Provides energy security.
3. Fits into sustainable development concept.
4. Reliable and the devices are modular in size.
5. Decentralized energy production.

2. Non- Renewable energy resources (or) Conventional energy resources

Natural resources which cannot be regenerated once they are exhausted. They cannot be used again.
Example: Coal, petroleum, natural gas, and nuclear fuels.

Even our renewable resources can become non-renewable if we exploit them to such extent their rate of consumption exceeds their rate of regeneration.
Wood is renewable resources but not coal-why?
Wood is renewable resources because we can get new wood by growing sapling into a tree within 15-20 years.
But the formation of coal from trees has taken million of years and cannot be regenerated in our life time.

1.16.5 RENEWABLE ENERGY RESOURCES

Renewable resources are parts of our natural environment and form our eco-system

1.16.1 SOLAR ENERGY

The energy that we get directly from the sun is called solar energy.
The nuclear fusion reactions occurring inside the sun release enormous amount of energy in the form of heat and light.
The solar energy received by the near earth space is approximately1.4 $kJ/s/m^2$ known as solar constant.

1.16.2 Methods of Harvesting Solar Energy

1. Solar cells (or) photovoltaic cells (or) PV cells

Solar cells consist of a p-type semiconductor (such as Si doped with B) and n-type semi-conductor (Si doped with P).

They are in close contact with each other.

When the solar rays fall on the top layer of p-type semi-conductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into n-type semi-conductor. There by potential difference between two layers is created, which causes flow of electrons (ie.,an electric current)

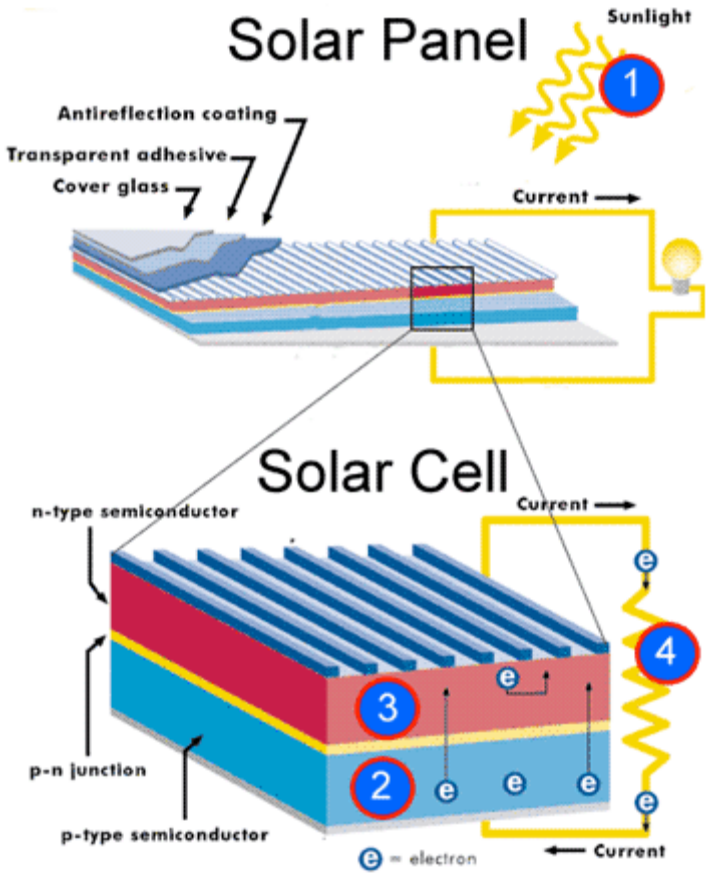

Fig.1.7 Solar cell

Uses

Used in calculators, electronic watches. Street lights, water pumps to run radios and TVs.

Solar Battery

When a large number of solar cells are connected in series it form a solar battery.

Solar battery produce more electricity which is enough to run water pump, to run street-light, etc.,

They are used in remote areas where conventional electricity supply is a problem.

2. Solar heat collectors

Solar heat collectors consists of natural materials like stones, bricks, (or) materials like glass, which can absorb heat during the day time and release it slowly at night.

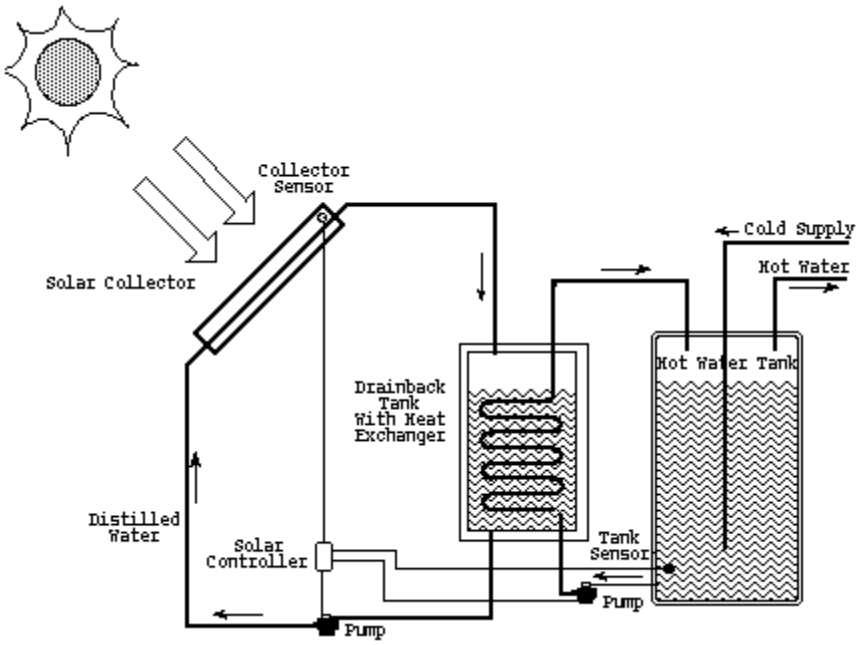

Fig. 1.8 Solar heat collector

Uses

Used in cold places, where houses are kept in hot condition using solar heat collectors.

3. Solar water heater

It consists of

An insulated box inside of which is painted with black paint.

Provided with a glass lid to receive and store solar heat.

Inside the box it has black painted copper coil, through which cold water is allowed to flow in, which gets heated up and flows out into a storage tank.

From the storage tank water is then supplied through pipes.

1.17 WIND ENERGY

Definition

Moving air is called wind.

Energy recovered from the force of the wind is called wind energy.

The energy possessed by wind is because of its high speed.

The wind energy is harnessed by making use of wind mills.

1.17.1 Harvesting of wind energy

1. Wind Mills

The strike of blowing wind on the blades of the wind mill makes it rotating continuously.

The rotational motion of the blade drives a number of machines like water pump, flour mills and electric generators.

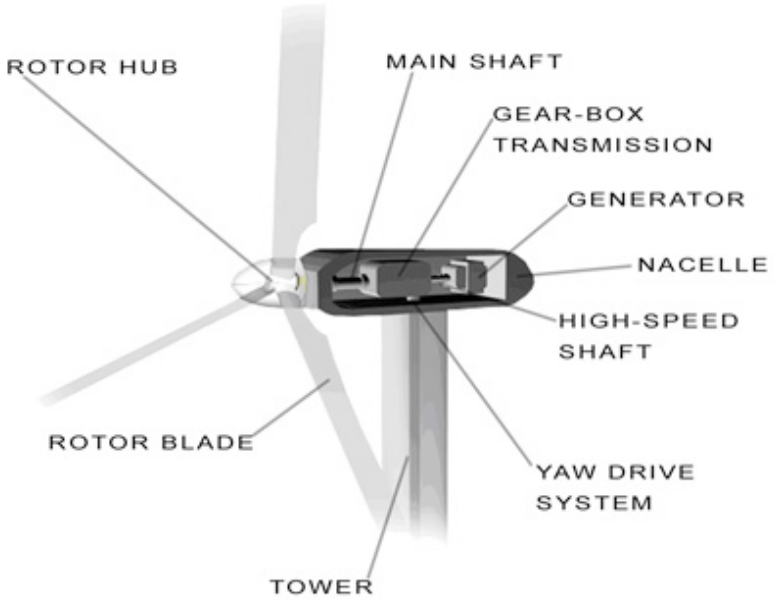

Fig. 1.9 Wind mill

2. Wind farms

When a large number of wind mills are installed and joined together in a definite pattern it forms a wind farm.

The wind farms produce a large amount of electricity.

Conditions

The minimum speed required for satisfactory working of a wind generator is 15 km/hr.

Advantages

It does not cause any air pollution

It is very cheap.

1.18 OCEAN ENERGY

It can be generated by following ways.

1. Tidal energy (or) Tidal power

Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.

The “high tide” and “low tide” refer to the rise and fall of water in the oceans.

The tidal energy can be harnessed by constructing a tidal barrage.

During high tide, the sea-water is allowed to flow into the reservoir of the barrage and rotates the turbine, which intern produces electricity by rotating the generators.

During low tide, when the sea level is low, the sea water stored in the barrage reservoir is allowed to flow into the sea and again rotates the turbine.

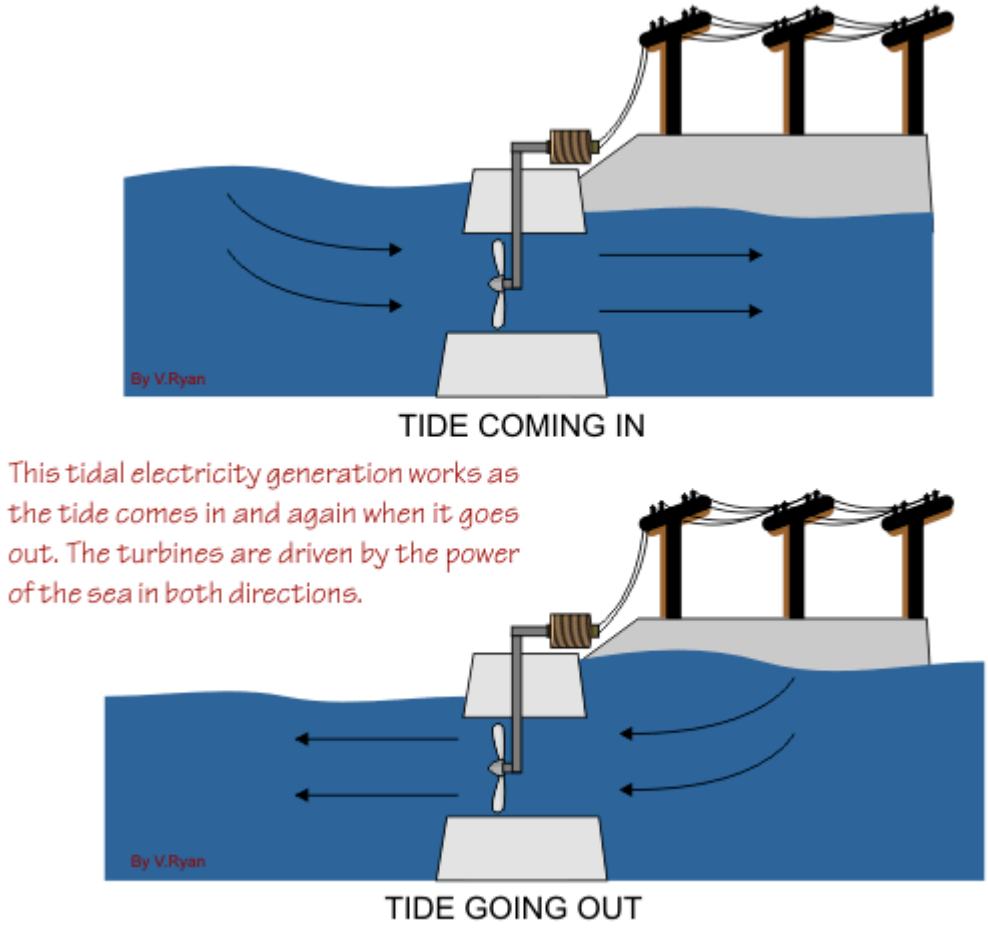

Fig. 1.10 Tidal energy

2. Ocean thermal energy (OTE)

There is often large temperature difference between the surface level and deeper level of the tropical oceans.

This temperature difference can be utilized to generate electricity.

The energy available due to the difference in temperature of water is called ocean thermal energy.

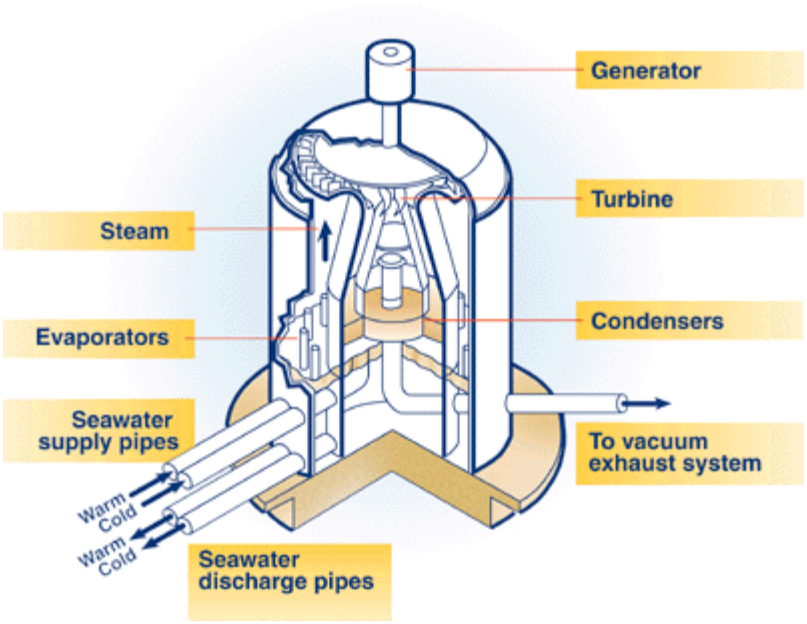

Fig. 1.11 Ocean thermal energy

Condition

The temperature difference should be of 20^0C or more is required between surface water and deeper water.

Process

The warm surface water of ocean is used to boil a low boiling liquid like ammonia.
The high vapour pressure of the liquid, formed by boiling is then to turn the turbine of the generator and generates electricity.
The cold water from the deeper ocean is pumped to cool and condense the vapour into liquid.

3. Geo-thermal Energy

1. Temperature of the earth increases at a rate of 20-75^0C per km, when we move down the earth surface.

2. High temperature and high pressure steam fields exists below the earth's surface in many places.

3. The energy harnessed from the high temperature present inside the earth is called geothermal energy.

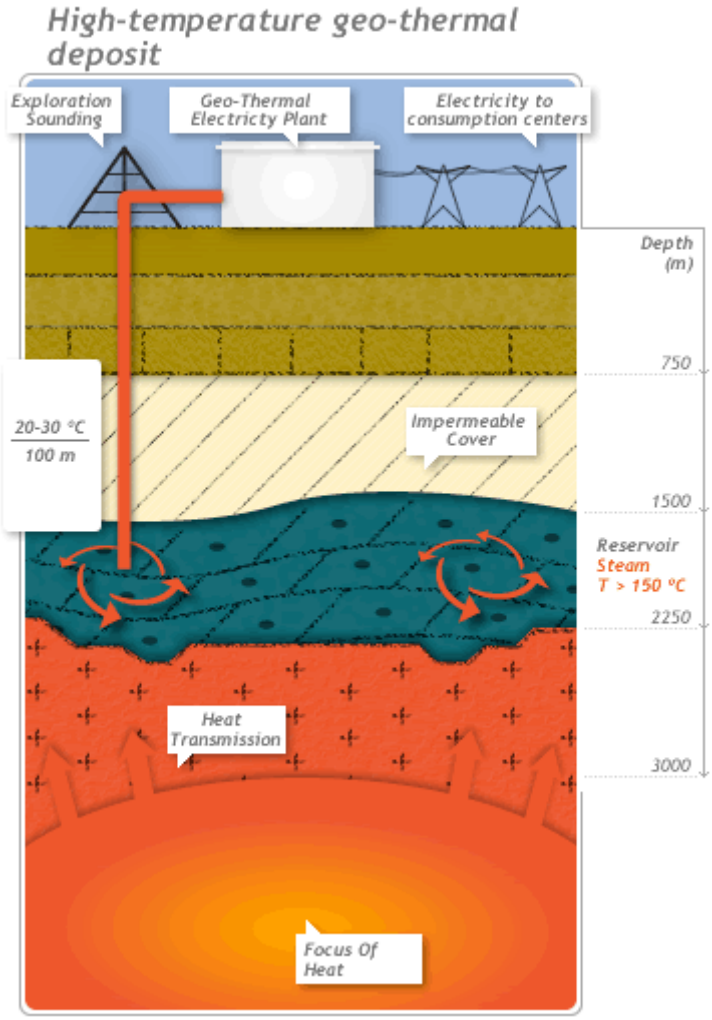

Fig. 1.12 Geothermal energy

1. Natural geysers

In some places, the hot water (or) steam comes out of the ground through cracks naturally in the form

2. Artificial geysers

In some places, we can artificially drill a hole up to the hot region and by sending a pipe in it, we can make the hot water or steam to rush out through the pipe with very high pressure.

Thus, the hot water (or) steam coming out from the natural (or) artificial geysers is allowed to rotate the turbine of a generator to produce electricity.

1.19 BIOMASS ENERGY

Biomass is the organic matter, produced by plants or animals, used as sources of energy.

Most of the biomass is burned directly for heating, cooling and industrial purposes.

Eg: Wood, crop residues, seeds, cattle dung, sewage, agricultural wastes.

Biogas
Mixture of methane, carbondioxide, hydrogen sulphide, ete.
It contains about 65% of methane gas as a major constituent
Biogas is obtained by the **anaerobic fermentation** of animal dung or plant wastes in the presence of water.

2. Bio fuels
Biofuels are the fuels, obtained by the **fermentation** of biomass.
Eg: Ethanol, Methanol

(a)Ethanol
Ethanol can be easily produced from the **sugarcane**. Its calorific value is less when compared to petrol, and produces much less heat than petrol.
(b)Methanol
Methanol can be easily obtained from **ethanol or sugar**-containing plants.
Its calorific value is also too low when compared to gasoline and diesel.
(c)Gasohol
Gasohol is a mixture of **ethanol+gasoline**.

In India trial is being carried out to use Gasohol in cars and buses.

Gasohol is common fuel in Brazil and Zimbabwe for running cars and buses.
Methanol is very useful since it burns at a lower temperature than gasoline or diesel. Due to its high calorific value, hydrogen can serve as an excellent fuel.
Moreover it is non-polluting and can be easily produced.
Presently H_2 is used in the form of liquid hydrogen as a fuel in spaceships.

Hydrogen Fuel

Hydrogen can be produced by **thermal dissociation** or **photolysis** or **electrolysis** of water.
It possesses high calorific value.
It is non polluting, because the combustion product is water.

$$2H_2+O_2\text{----}>2H_2O+150KJ$$

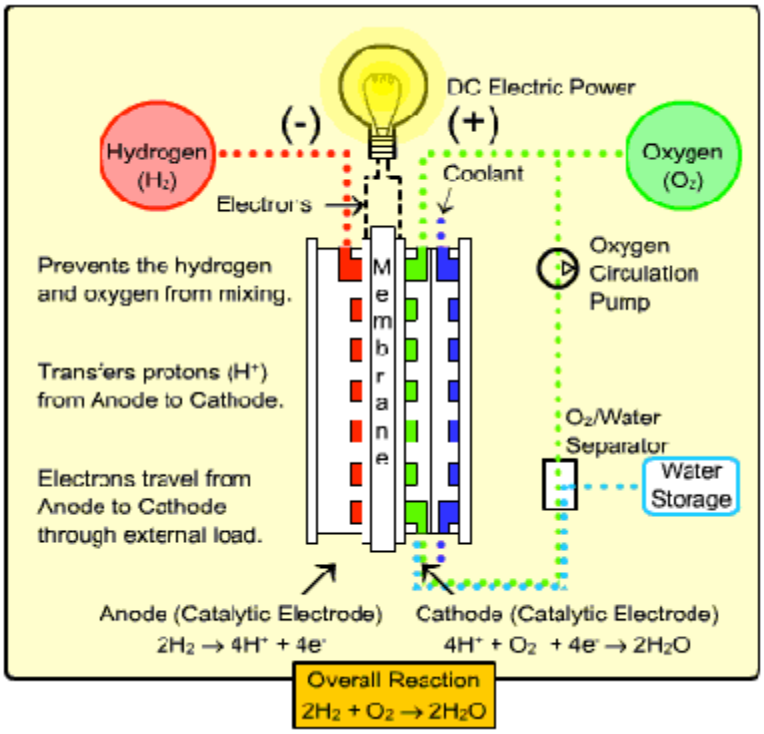

Fig. 1.13 Hydrogen fuel cell

Disadvantages of hydrogen fuel

Hydrogen is highly inflammable and explosive in nature
Safe handling is required
It is difficult to store and transport.

1.20 NON-RENEABLE ENERGY SOURCES

1.20.1 Coal

Coal is a solid fossil fuel formed in several stages as buried remains of land plants that lived 300-400 million years ago were subjected to intense heat and pressure over millions of years.

Various stages of coal

Wood → Peat → Lignite → Bituminous coal → Anthracite

1. The carbon content of Anthracite is 90% and its calorific value is 8700 k.cal.
2. The carbon content of bituminous, lignite and peat are 80, 70 and 60% respectively
3. India has about 5% of world's coal. Indian coal is not good because of poor heat capacity.

Disadvantages

1. When coal is burnt it produces CO_2 causes global warming
2. Since coal contains impurities like S and N, it produces toxic gases during burning.

1.20.2 Petroleum

Petroleum or crude oil = hydrocarbons +small amount S, O, N.

Occurrence

The fossil fuel formed by the decomposition of dead animals and plants that were buried under lake and ocean at high temperature and pressure for million years

Fractional distillation

Hydrocarbons are separated by fractioning the crude oil.

Petroleum World Scenario

1. 67% oil reserves.
2. 25% of the oil reserves in Saudi Arabia.

At the present rate of usage, the world's crude oil reserves are expected to get exhausted in just 40 years.

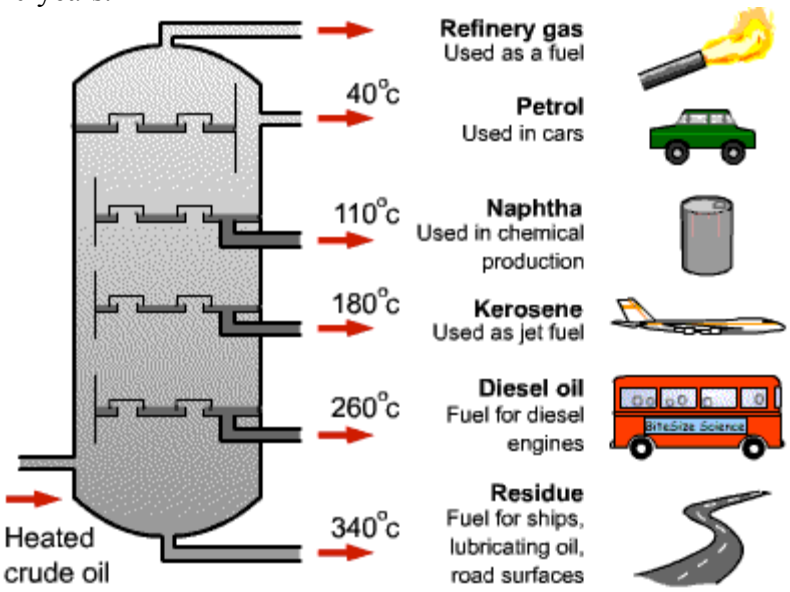

Fig. 1.14 Fractionating column

1.20.3 LPG (Liquefied Petroleum Gas)

1. The petroleum gas, **converted into liquid** under high pressure as LPG
2. LPG is colorless and odorless gas.
3. During bottling some **mercaptans** is added, to detect leakage of LPG from the cylinder.

1.20.4 Natural Gas

1. Mixture of **50-90% methane** and small amount of other **hydrocarbons.**
2. Its calorific value ranges from 12,000-14,000 k-cal/$m^{3.}$

(i)Dry gas

If the natural gas contains lower hydrocarbons like methane and ethane, it is called dry gas.

(ii)Wet gas

If the natural gas contains higher hydrocarbons like propane, butane along with methane it is called wet gas.

Occurrence

Formed by the decomposition of dead animals and plants, those were buried under lake and ocean, at high temperature and pressure for millions of years.

1.21 NUCLEAR ENERGY

Dr. H. Bhabha –father. India has 10 nuclear reactors, which produce 2% of India's electricity.

1.21.1 Nuclear Fission

Heavier nucleus is split into lighter nuclei, on bombardment by fast moving neutrons, and a large amount of energy is released.

Eg:

Fission of U^{235}

When U^{235} nucleus is hit by a thermal neutron, it undergoes the following reaction with the release of 3 neutrons.

$$U_{92}{}^{235} + n^{1}{}_{0} \rightarrow Ba^{139}{}_{56} + Kr\,{}^{94}{}_{36} + 3n^{1}{}_{0} + \text{Energy}$$

Each of the above 3 neutrons strikes another U^{235} nucleus causing (3x3) 9 subsequent reactions. These 9 reactions further give rise to (3x9) 27 reactions.

This process of propagation of the reaction by multiplication in threes at each fission is called **chain reaction.**

Fission reaction of U^{235} is given below.

$$_{92}U^{235} + {}_{0}n1 \longrightarrow {}_{36}Kr^{92} + {}_{56}Ba^{141} + 3\ {}_{0}n^{1} + \text{energy}$$

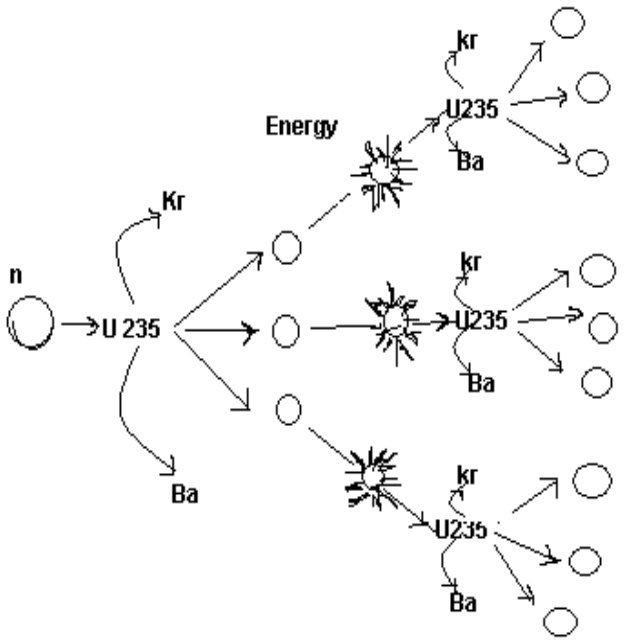

Fig. 1.15 Nuclear fission-chain reaction

1.21.2 Nuclear fusion:

Lighter nucleuses are combined together at extremely high temperatures to form heavier nucleus and a large amount of energy is released.

Eg:

Fusion of H^2_1 .Two hydrogen-2 (Deuterium) atoms may fuse to form helium at 1 billion^{0}C with the release of large amount of energy

$$_1H^2 + _1H^2 \longrightarrow {}_3He^2 + {}_0n^1 + \text{energy}$$

Nuclear power of India

Tarapur(Maharashtra),
Ranapratap Sagar (Rajasthan)
Kalpakkam (Tamilnadu)
Narora (U.P).

1.22 USES OF ALTERNATE (RENEWABLE) ENERGY SOURCES

Why Alternate (Renewable) Energy Sources are required?

The importance of solar energy can be emphasized particularly in view of the fact that fossil fuels and other conventional sources are not free from environmental implications.

least pollution, safety and security snags and are **universally available** have the best enhance of large scale utilization in future

Hydro-electric power generation is expected to upset the ecological balance existing on earth Besides space heating, hydel power plants critically pollute the aquatic and terrestrial biota.

Radioactive pollutants released from nuclear power plants are chronically hazardous.

The commissioning of boiling water power reactors (BWRS) have resulted in the critical accumulation of large number of long lived radionuclides in water\

The **dangerous radiowaste** cannot be buried in land without the risk of polluting soil and underground water.

Nor the waste can be dumped into the rivers without poisoning aquatic life and human beings as well

The burning of **coal, oil, wood, dung cakes and petroleum** products has well debated environmental problems. The smoke so produced causes respiratory and digestive problems leading to lungs, stomach and eye diseases.

The **disposal of fly ash** requires large ash ponds and may pose a severe problem considering the limited availability of land. Thus the non-conventional sources of energy are needed.

Objectives

To provide more energy to meet the requirements of increasing population.
To reduce environmental pollution
To reduce safety and security risks associated with the use of nuclear energy.

1.23 LAND RESOURCES

It provides food, fibre, wood, medicine and other biological materials

Soil is the mixture of inorganic materials (rocks and minerals) and organic materials (dead animals and plants).

Top soil is classified as renewable resources.

Uses of land resources

Land provide, food, wood, minerals, etc., for us
Land nurtures the plants and animals that provide our food and shelter.
Land is used as watershed or reservoir
Land acts as a dust bin for most of the wastes, created by the modern society.
Land is used for construction of buildings, industries.

1.23.1 LAND DEGRADATION

Process of degradation of soil or loss of fertility of the soil.

Harmful effects of land degradation

The soil texture and soil structure are deteriorated
Loss of soil fertility, due to loss of invaluable nutrients
Increase in water logging, salinity, and alkalinity and acidity problems.
Loss of economic social and biodiversity.

Causes of land degradation

1. Population

Land resources degraded by over population &over exploitation.

2. Urbanization

Urbanization leads to deforestation, reduces the land

3. Fertilizers and pesticides

Increased applications of fertilizers and pesticides leads to pollution of land and water and soil degradation.

4. Damage of top soil

Increase in food production generally leads to damage to top soil through nutrient depletion.

5. Water-logging

Soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation.

6. Soil erosion

Soil erosion is the process of removal of superficial layer of the soil from one place to another.

Harmful effects of soil erosion

Soil fertility is lost because of loss of top soil layer.
Loss of its ability to hold water and sediment.
Sediment runoff can pollute water and kill aquatic life.

Types of soil erosion

(i)Normal erosion

Gradual removal of top soil by the **natural process.**
The rate of erosion is slower.

(ii)Accelerated erosion

Caused by man-made activities

The rate of erosion is much faster than the rate of formation of soil.

Man induced 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.
Earlier there were few reports of landslides between Rishikesh and Byasi on Badrinath Highway area. But, after the highway was constructed, 15 landslides occurred in a single year.
During the construction of roads, mining activities etc. huge portions of fragile mountainous areas are cut or destroyed by dynamite and thrown into adjacent valleys and streams.
These land masses weaken the already fragile mountain slopes and lead to landslides.
They also increase the turbidity of various nearby streams, thereby reducing their productivity.

Causes of soil erosion

(i)Water

Affects soil erosion in the form of rain, run-off, rapid flow, wave action.

Sheet erosion: When there is uniform removal of a thin layer of soil from a large surface area, it is called sheet erosion.

Rill erosion: when there is rainfall and rapidly running water produces finger-shaped grooves or rills over the area, it is called rill erosion.

Gully erosion: When the rainfall is very heavy, deeper cavities or gullies are formed, which may be U or V shaped.

Slip erosion: This occurs due to heavy rainfall on slopes of hills and mountains.

Stream bank erosion: During the rainy season, when fast running streams take a turn in some other direction, they cut the soil and make caves in the bank.

(ii)Wind

Wind is the important climatic agent, who carry away the fine particles of soil and creates soil erosion.

Saltation: This occurs under the influence of direct pressure of stormy wind and the soil particles of 1-1.5 mm diameter move up in vertical direction.

Suspension: Here fine soil particles (less than 1mm diameter) which are suspended on the air are kicked up and taken away to distant places.

Surface creep: Here the large particles (5-10 mm diameter) creep over the soil surface along with wind.

(iii)Biotic agents

Overgrazing, mining and deforestation are the major biotic agents, cause soil erosion.
Deforestation without reforestation, overgrazing by cattle, surface mining without land reclamation, irrigation techniques that lead to salt build- up, water logged soil, make the top soil vulnerable to erosion.

.

35% of world soil erosion is due to overgrazing.
30% of world soil erosion is due to deforestation.

(iv) Landslides

-Causes soil erosion.

(v)Construction

-Construction of dams, buildings, roads removes the protective vegetal cover and leads to soil erosion.

Control of soil erosion (or) soil conservation practices

1. Conservational till farming (or) no-till-farming

In tradition method, the land is ploughed and soil is broken up and leveled to make a planting surface.

This disturbs the soil and makes it susceptible to erosion

However, no-till-farming causes minimum disturbance to the top soil

Here the tilling machines make slits in the unploughed soil and inject seeds, fertilizers and water in the slit. So the seed germinates and the crop grows.

2. Contour farming

It involves **planting crops** in rows across the contour of **gently sloped land.**

Each row acts as a small dam to hold soil and to slow water runoff.

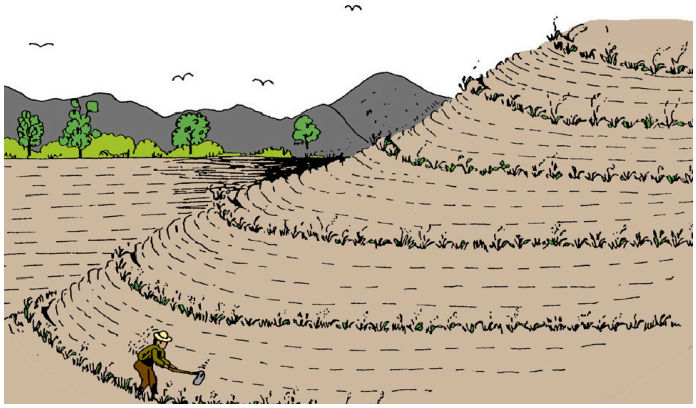

Fig. 1.16 Contour farming

3. Terracing

It involves conversion of **steep slopes into broad terraces**, which run across the contour.

This retains water for crops and reduces soil erosion by controlling runoff.

Fig. 1.17 Terracing

4. Alley cropping (or) Agro forestry

It involves **planting crops in strips** or **alleys between rows** of **trees of shrubs** that can provide fruits and fuel wood.

Even when the crop is harvested, the soil will not be eroded because trees and shrubs still remain on the soil and hold the soil particles.

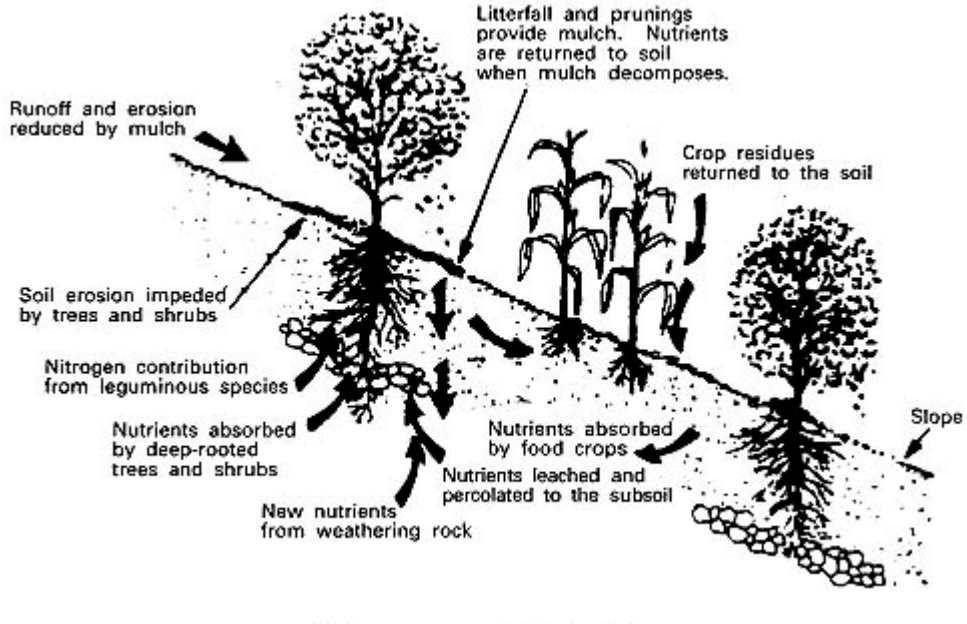

Fig. 1.18 Alley cropping

5. Wind breaks or shelter belts

The **trees** are planted in long rows along the boundary of cultivated lands, which **block the wind** and **reduce soil erosion**.
Wind breaks help in retaining soil moisture, supply of some wood for fuel and provide habitats for birds.

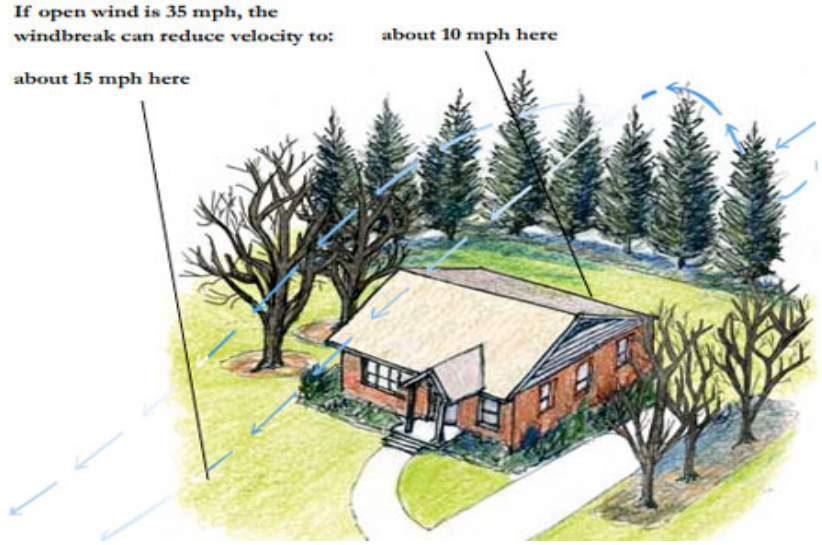

Fig. 1.19 Wind breaks

1.24 DESERTIFICATION

Progressive destruction or degradation of arid or semiarid lands to desert.
Desertification leads to the conversion of range lands or irrigated croplands to desert.
Desertification is characterized by devegetation, depletion of ground water, salination and soil erosion.

Harmful effect of desertification

Around 80% of the **productive land** in the arid and semi-regions are **converted into desert.**
Around 600 million people are threatened by desertification.

Causes of Desertification

(a)Deforestation

The process of denuding and degrading a forest land initiates a desert.
If there is no vegetation to hold back the rain water, soil cannot soak and groundwater level do not increases.
This also increases, soil erosion, loss of fertility.

(b)Over grazing

The increase in cattle population heavily grazes the grass land or forests and as a result denudes the land area.
The denuded land becomes dry, loose and more prone to soil erosion and leads to desert.

(c)Water management

Over utilization of ground water, particularly in the coastal regions, is resulting in saline water intrusion into aquifers which is unfit for irrigation.

(d)Mining and quarrying

These activities are also responsible for loss of vegetal cover and denudation of extensive land area leading to desertification.

(e)Climate change
Formation of deserts may also take place due to climate change, ie., failure of monsoon, frequent droughts.
(f)Pollution
Excessive use of fertilizers and pesticides and disposal of toxic water into the land also leads to desertification.

1.25 LANDSLIDES

Landslides are the downward and outward movement of a slope composed of earth materials such as rock, soil, artificial fills. Other names of landslides are **rockslide, debris slide, slump**, **earth flow and soil creep.**

Man induced landslides
During **construction of roads and mining activities** huge portions of **fragile mountainous areas are cut and thrown into adjacent areas and streams**. These land masses weaken the already fragile mountain slopes and lead to landslides called man induced landslides.

Causes of landslides
1. Removal of vegetation
In the sloppy area creates soil erosion, which leads to landslides.
2. Underground mining
Cause subsidence of the ground.
3. Transport
Due to the movement of buses and trains in the unstable sloppy region cause landslides.
4. Addition of weight
Addition of extra weight (or) construction on the slope areas leads to landslide.
5. Ground water level
Over exploitation of ground water also leads to landslides.
Harmful effect of landslides
Landslide increases the turbidity of nearby streams, thereby reducing their productivity.
Destruction of communication links.
Loss of habitat and biodiversity.
Loss of infrastructure and economic loss.

1.26 CONSERVATION OF NATURAL RESOURCES - ROLE OF AN INDIVIDUAL

Different natural resources like forests, water, soil, food, mineral and energy resources play a vital role in the development of a nation. While conservation efforts are underway at National as well as International level, the individual efforts for conservation of natural resources can go a long way.

I. Conserve Water

Don't keep water taps running while brushing, shaving, washing or bathing.

Check for water leaks in pipes and toilets and repair them promptly. A small pin-hole sized leak will lead to the wastage of 640 liters of water in a month.
Use drip irrigation and sprinkling irrigation to improve irrigation efficiency and reduce evaporation.
Install a small system to capture rain water and collect normally wasted used water from sinks, cloth-washers, bathtubs etc. which can be used for watering the plants
Build rain water harvesting system in your house. Even the President of India is doing this.

II. Conserve energy

Turn off lights, fans and other appliances when not in use.
Obtain as much heat as possible from natural sources. Dry the clothes in sun instead of drier if it is a sunny day.
Use solar cooker for cooking your food on sunny days which will be more nutritious and will cut down on your LPG expenses.
Grow deciduous trees and climbers at proper places outside your home to cut off intense heat of summers and get a cool breeze and shade. This will cut off your electricity charges on coolers and air-conditioners.
Try riding bicycle or just walk down small distances instead of using your car or scooter.

III. Protect the soil

While constructing your house, don't uproot the trees as far as possible. Plant the disturbed areas with a fast growing native ground cover.
Make compost from your kitchen waste and use it for your kitchen-garden or flower-pots.
Do not irrigate the plants using a strong flow of water, as it would wash off the soil.
If you own agricultural fields, do not over-irrigate your fields without proper drainage to prevent water logging and salinisation.
Use mixed cropping so that some specific soil nutrients do not get depleted.

IV. Promote Sustainable Agriculture

Do not waste food. Take as much as you can eat
Reduce the use of pesticides.
Fertilize your crop primarily with organic fertilizers.
Eat local and seasonal vegetables. This saves lot of energy on transport, storage and preservation.
Control pests by a combination of cultivation and biological control methods.

1.27 EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLE

There is a big divide in the world as North and South, the more developed countries (MDC'S) and less developed countries (LDC'S), the haves and the have nots.

The MDC's have only 22% of world's population, but they use 88% of its natural resources, 73% of its energy and command 85% of its income.
As the rich nations continue to grow, they will reach a limit.
If they have a growth rat of 10% every year, they will show 1024 times increase in the next 70 years.
Will this much of growth be sustainable? The answer is 'No' because many of our earth's resources are limited and even the renewable resources will become unsustainable if their use exceeds their regeneration.
Thus, the solution to this problem is to have more equitable distribution of resources and wealth.
We cannot expect the poor countries to stop growth in order to check pollution because development brings employment and the main problem of these countries is to tackle poverty.
The poor in the LDC'S are at least able to sustain their life.
Unless they are provided with such basic resources, we cannot think of rooting out the problems related to dirty, unhygienic, polluted, disease infested settlements of these people-which contribute to unsustainability.
Thus, the two basic causes of unsustainability are over population in poor countries who have under consumption of resources and over consumption of resources by the rich countries, which generate wastes.
In order to achieve sustainable life styles it is desirable to achieve a more balanced and equitable distribution of global resources and income to meet everyone's basic needs.
The rich countries will have to lower down their consumption levels while the bare minimum needs of the poor have to be fulfilled by providing them resources.
A fairer sharing of resources will narrow down the gap between the rich and the poor and will lead to sustainable development for all and not just for a privileged group.