UNIT III

NATURAL RESOURCES

Earth depends on a large number of things and services provided by the nature. A **resource** is
anything obtained from the environment to meet our needs and wants. Material resources obtained from the environment are classified as perpetual (such as sunlight, winds and flowing water), renewable (such as fresh air and water, soils, forest products and food crops), or nonrenewable (such as fossil fuels, metals and sand)

PERPETUAL RESOURCES:
On a human time scale it is renewed continuously e.g. solar energy. It also includes indirect forms of solar energy such as winds and flowing water.

RENEWABLE RESOURCES:
Renewable resources can be replenished fairly rapidly through natural processes as long as it is not used up faster than it is replaced. Renewable resources are inexhaustible and can be regenerated within a given span of time e.g. forest, wild life, wind energy biomass energy, tidal energy hydro power etc.

NONRENEWABLE RESOURCES:
Non-renewable resources exist in a fixed quantity or stock in the earth's crust. Non-renewable resources which cannot be regenerated within a short span of time e.g. fossil fuel like coal, petroleum minerals etc. Once we exhaust these reserves the same cannot be replenished. Even renewable resources can become non renewable if we exploit them to such extent that their rate of consumption exceeds their rate of regeneration. It is very important to protect and conserve our natural resources and use them in a judicious manner so that we don't exhaust them. v It doesn't mean that we should stop using most of natural resources We should use the resources in such a way that we always save enough of them for our future generations.

FOREST RESOURCES

Forest is one of the land area inhabited by dense growth of trees herbs & shrubs. Maximum biodiversity has been noticed in the forest area.

- v Produce innumerable material good.
- v Provide environmental services essential for life.
- v About 1/3 of the worlds land area is forested which includes closed as well as open forests.
- v The cover of natural forest has declined over the years.
- v The greatest loss occurred in tropical Asia where 1/3rd of the forest resources have been destroyed.

USES OF FOREST:

Commercial uses:
Forest provide us a large number of commercial goods which include timber, firewood, pulpwood

Ecological uses:

A typical tree produces commercial goods work about $590 whereas it provides environmental services worth nearly $ 196250.
Ecological services provided by our forests are as follows.

ν **Production of oxygen**:

The trees produce O_2 by photosynthesis which is so vital for life on this earth. They are rightly called as earth's lungs.

ν**Reducing global warming:**

The forest canopy act as a sink for CO_2 thereby reducing the problem of global warming caused by green house gas CO_2.

ν **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.

ν **Regulation of hydrological cycle:**

Forests water sheds act, like giant sponges absorbing rainfall, slowing down the run off and slowly releasing the water for recharge of springs.

ν **Soil conservation:**

Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as wind breaks.

ν **Pollution moderators:**

Forests can absorb many toxic gases and can help in keeping the air pure. They have also been reported to absorb noise and thus help in preventing air and noise pollution.

EXPLOITATION OF FOREST RESOURCES:

With growing civilization the demands for raw material like timber, pulp, minerals, fuel wood etc.,shoot up resulting in large scale logging, mining and road building and clearing of forest.

Our forests contribute substantially to the natural economy. Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and over grazing have together led to over exploitation of our forest leading to their rapid degradation.

In the world nearly about 30% of the area is covered by the forest.

Developing countries are rapidly over exploiting their forest wealth by the following two ways.

(i) Increasing agricultural production by destroying forests

(ii) Wood used as fuel.

It is reported that Central American countries may lose forests within next 50 years. Ethiopia has last all but the remaining 3.5% of its forests. Srilanka may lose valuable tropical forest within a period of 20 years. Thailand lost 45% of it forest up to 1985. Indonesia is chopping rain forest at the rate of one million hectares a year. In Philliphines, 60% of the forests have been cut during the last 30 years.

It is important to reduce the gap between demand and supply of forest material through regeneration of forests.

DEFORESTATION:

The destruction of forests cover by the activities of man and domestic animals is called deforestation.

The total forest area of the world in 1900 was estimated to be 7000 million ha which was reduced to 2890 million ha in 1975 and fell down to just 2300 million ha by 2000.

Deforestation rate is relatively less in temperate countries but it is very alarming in tropical countries, where it is as high as 40-50% and at the present rate it is estimated that in the next 60 years, we would lose more than 90% of our tropical forests.Now the rate of deforestation

has been estimated to be between 25.55 ha / min. The deforestation in India is about 3.5 million ha /year. Asia has lost almost 95% of its frontier forest.

MAJOR CAUSES OF DEFORESTATION:

1. **Growth of human population:**

Due to over population requirements of paper shelter, wood, timber, has been increased. Man has utilized larger area of forests for housing agriculture, factories & railway tracts.

2. Shifting cultivation:

The replacement of natural forest for monoculture can lead disappearance of number of plant and animal species. 300 million people lived by shifting cultivation. They are supposed to clear 5 lakhs ha / annum.

3. Industries & Road, Dam construction:

It causes destruction of forest or submergence of forest under water. Hence developmental activities in the forest area should be discouraged

4. Mining:

Mining activities destroys forest areas

5. Timber extraction:

Due to the increase in the population, the demand for wood also increases which led to deforestation.

6. Over grazing:

It exposes the soil to erosion by water and wind, compact the soil (which diminishes its capacity to hold water) and is a major cause of desertification.

7. Fuel Requirement:

Increase in demand for fuel wood has shoot up to 300 – 500 Million tons in 2001, compared to 65 Million ton during independence.

EFFECTS OF DEFORESTATION:

1. Soil erosion:

The fertile topsoil is eroded due to deforestation, which eventually leads to desertification. 6000 million tons of soil gets eroded every year in India.

2. Loss of biodiversity:

Destruction of habitat causes extinction of wild life, which in turn affects ecosystem.

3. Climate change:

Deforestation disrupts the climate pattern which cause drought in one area and heavy rain in another area.

4. Global warming:

The cutting & burning of forest trees increase the CO_2 content in the atmosphere, which in turn changes the global climate pattern, rising sea levels and depletion of protective ozone layer.

5. Loss of genetic diversity:

The destruction of our forest destroys the greatest store house of genetic diversity on earth, which provides new food and medicine for the entire world.

6. Hydrological cycle disruption:

Deforestation shifts the hydrologic cycle which cause change in the rainfall pattern in turn affects the food production.

7. Land slide and floods:

Due to the absence of the trees as barrier, the hilly regions suffer heavy floods and land slides

CASE STUDIES:

Deforestation in hilly regions:

Deforestation in Himalayas involves clearance of natural forest & Plantation of Monocultures like Pinus, Roxburg, Eucalyptus, Camadulensis etc., have upset the ecosystem, by changing various soil and biological properties. The original rich germplasm is lost due to this activity. Areas are invaded by exotic weeds. Areas are not able to recover & losing the fertility.The entire west Khosi hill district of Megahalaya in NorthEastern Himalayas, Ladakh, parts of Kumaon are now facing serious problems of deforestation. Disappearing Tea gardens in Chhota Nagpur:This hilly region used to be a good forested area, and used to receive fairly frequent afternoon showers favouring tea plantation. Towards the turn of the century, following the destruction of forest,rainfall decline in Chhota Nagpur to such an extent that tea garden also disappeared.

Preventive measures:

1. Creating awareness.
2. Strict implementation of law of forest conservation act.
3. To counter deforestation, afforestation and social forestry should be adopted.
4. To discourage the Migration of people into the islands from Mainland.

TIMBER EXTRACTION:

Uses of timber: Pulp and paper, composite wood furniture, railways, boats and road construction.

CONSEQUENCES OF TIMBER EXTRACTION:

1. Deforestation
2. Soil erosion, loss of fertility, land slides and loss of biodiversity.
3. Loss of tribal culture & extinction of tribal people.
4. Reduce the thickness of the forest.

Indian Scenario:

Industries consume 28 Million cu.mts / year of wood, but annual forest growth is only about 12 Million cu.mts / year

MINING:

Mining is the process of extracting mineral resources and fossil fuels from the earth.

Surface Mining – shallow deposits

Subsurface mining – deep deposits

80,000ha land of the country is under the stress of mining activities.

Mining and its associated activities required removal of vegetation along with underlying soil Mantle and overlying rock Masses, this result in defacing the topography and destruction of the landscape in the area. Large scale deforestation has been repeated in Missouri and Dehradun valley due to indiscriminate Mining of various minerals over a length of about 40 km. The forest area has declined at an average rate of 33% and the increase in non – forest area due to Mining activities resulted in unstable zone leading to landslides.

Indiscriminate Mining in forest in Goa, 1961 destroyed more than 50,000 ha of forest land. Coal mining in Raniganj cause deforestation. Mining of Magnesite and soap stones have destroyed 14 ha in Khirakut, Kosi, Almora.

Mining of radioactive Mineral in Kerala, TamilNadu and Karnataka rose similar threats of deforestation. Rich forest of Western Ghats is also facing the same threat due to Mining projects for excavation of copper, chromite, bauxite, Magnesite

EFFECTS OF MINING:

1. Mining activity not only destroy trees. It also pollutes soil, water, with heavy Metal toxins that are almost impossible to remove.
2. Destruction of natural habitat
3. Due to continuous removal of Minerals & forest covers, trenches are formed on ground leading to water logged area which in turn contaminate ground water
4. Noise pollution due to Mining operations
5. Lands slides may also occur as a result of continuous Mining in forest area.

TIMBER EXTRACTION AND MINING:
The major activities in forest area are 1. timber extraction 2. mining
The important effects of timber extraction are
i) thinning of forests
ii) loss of biodiversity, particularly tree breading species
iii) soil erosion and loss of soil fertility
iv) migration of tribal people from one place to another in search of new forest
v) extinction of tribal people and their culture

MINING:
Mining is a process of removing ores from area which is very much below the ground level. Mining is done for the extraction of several minerals of metals like Fe, Mn, Au, Ag,etc. The minerals are especially found in thick forests.

Mining can be carried out in two ways
1. Surface mining
2. underground mining or sub-surface mining

The effects of under ground mining on forest reserves is comparatively less than that of surface mining

Relation between forest and climate change:
Forests both influence and influenced by climate change. They play an important role in the carbon cycle and the way we manage forests could significantly affect global warming.
Forests hold more than 50 per cent of the carbon that is stored in terrestrial vegetation and soil organic matter. Hence, deforestation contributes significantly to net emissions of carbon dioxide into the atm. If the predicted global warming occurs, the impact on forests is likely to be regionally varied, dramatic, and long-lasting. Even now, we can see how any extreme weather has great impact on forests. For example, the 1999 storms in Europe caused heavy damage to forests and also to trees outside forest areas.
The Kyoto Protocol on climate change may have a great impact on forest management. Under the Protocol, a country with forests earns emission credits, since its forests absorb carbon dioxide. These credits are tradable, that is, a developing country can sell its credits to an industrialized country that has exceeded its quota of emissions. The latter would invest in afforestation and reforestation projects in the developing country.

DAMS – BENEFITS AND PROBLEMS

River valley projects with big dams are considered to play a key role in the development of a country.
India has large number of river valley projects
1. These dams are regarded as symbol of national development.
2. generate electricity
3. reduce power and water shortage
4. provide irrigation water
5. provide drinking water to remote areas
6. promote navigation and fishery.

Environmental problems:
The environmental problems can be at upstream as well as downstream
Level
Upstream problems
1. Displacement of tribal people
2. Loss of flora and fauna
3. siltation and sedimentation near reservoir
4. stagnation and water logging near reservoir
5. growth of aquatic weeds
6. micro climatic changes
7. RIS causes earthquakes
8. breeding of disease vectors
Downstream problems
1. Water logging and salinity due to over irrigation
2. micro climatic changes
3. salt water intrusion at river mouth
4. loss of fertility due to sediment deposits
5. out break of vector born diseases.

DAMS AND THEIR EFFECTS ON FOREST AND PEOPLE:
India has more number of river valley projects (RVP) referred to as "Temples of Modern India".Dams are responsible for the destruction of vast areas of forest.India has more than 1550 large dams. Maximum number of dams in the state of Maharastra (600) followed by Gujarat (more than 250) and Madhya Pradesh (130). The highest one is Tehri dam on river Bhagirathi in Uttranchal & the largest in terms of capacity in Bhakra dam on river Sutlej in Himachal Pradesh. Big dams have been in sharp focus of various Environmental groups all over the world which is mainly because of several ecological problems related to tribal or native people associated with them.

EFFECTS OF DAM ON FOREST:
Floods, drought & land slides become more prevalent in mining area
v The impounding of water in the dam may create Major / Minor earthquakes and leads to flood in the down stream side of a dam.
v Forests are the repositories of invaluable gifts of nature in the form of biodiversity. By destroying them, we are going to lose these species even before knowing them.
v These species could be having marvelous economic or medicinal value and deforestation results in loss of their store house of species, which have evolved over millions of years in single stroke.
EFFECTS OF DAM ON TRIBAL PEOPLE

1. The greatest social cost of big dam is wide spread displacement of tribal people.
2. The displacement & cultural change affects the tribal people mentally (or) physically. They do not accommodate the modern food habits and life styles.
3. Tribal people may be ill treated by modern society
4. Tribal people & their culture cannot be questioned and destroyed.
5. Many of the displaced people were not recognized and resettled (or) compensated (Environmental refugees)

world forest day – march 21st

Sardar Sarovar Dam (uprooted forests and Tribes):

A case study:

The dam is situated on river Narmada and is spread over three states of Gujarat, Maharashtra and Madhya Pradesh. Although the project is aimed at providing irrigation water, drinking water and electricity to three states, the environmental impacts of the project have raised challenging questions.

A total of 1, 44,731 ha of land will be submerged by the dam, out of which 56,547 ha is forest land. A total of 573 villages are to be submerged by the Narmadha Dam.

Submergence of about 40,000 ha of forest under Narmada sagar, 13,800 ha under Sardar Sarovar and 2,500 ha under Omkareshwar would further create pressure on remaining forest areas in adjoining areas submergence area is very rich in wild life e.g. tigers, panthers, bears, wolves, pangolins, hyenas, jackals, flying squirrels, antelopes, black bucks, chinkara, marsh crocodiles, turtles etc. Many of these species are listed in schedule 1 & 11 of wild life protection Act, 1972. Thus massive loss of these wild life species is apprehended due to the devastation of the forest under the project.As per the estimates of the Institute of urban Affairs, New Delhi, the Narmadha Valley project will lead to eventual displacement of more than one million people, which is probably the largest rehabilitation issue ever encountered as per the world Bank. Uprooting of the tribes and their forced shifting in far – flung areas may not be easily adjusted to. Besides serious economic deprivation, the displacement will affect the tribal people's culture, their beliefs, myths and rituals, festivals, songs and dances, all closely associated with the hills, forests and streams.It is therefore the duty of the project proponents and government to pay maximum attention for proper rehabilitation of the displaced tribes.

WATER RESOURCES

World Water Day – March 22

About 71% of the earth surface is salt water. All the organisms are made up mostly of water.

* A tree is about 60% water by weight
* Animals having 50 – 65 % water. v It plays a major role in sculpting earth's surface, Moderating climate, diluting pollutants.

IMPORTANT PROPERTIES OF WATER:

v There are strong forces of attraction between molecules of water (Hydrogen bond)

v Water exists as a liquid over a wide temperature range because of the strong forces of attraction between water Molecules.

v Its high boiling point 100°C and low freezing point 0_oC means that H_2O remains a liquid in most climates on the earth.

v Water changes temperature slowly because it can store a large amount of heat without a large change in temperature. High heat capacity helps (1 cal / 1°C/ 1 gm)

(i) Protect living organism from temperature fluctuation.
(ii) Moderates climates
(iii) Excellent coolant.
· Evaporating liquid water takes large amounts of heat because of strong force of attraction between its molecules.
1. H_2O absorbs large amount of heat as it changes into H_2O vapor and releases this heat as the vapour condenses back to liquid
2. This helps distribute heat throughout the world
· It can dissolve a variety of compounds
- It enables it to carry dissolved nutrients to tissues.
- It flushes the waste products out of those tissues.
- It serves as an all – purpose cleaner
- It helps to remove and dilute the water soluble wastes of civilization.

It can ionize water Molecules into H^+ & OH^-
- To maintain a balance between acids & bases in cell organism
- Water filters out the wavelengths of UV radiation that would harm some aquatic organism.
· Strong attractive forces between the molecules of water cause it surface to contract and to adhere to and coat a solid.
. Water expands when it freezes and becomes less dense than water. Otherwise lakes and streams in cold climate would freeze solid and lose most of their current forms of aquatic life.
- H_2O expands on freezing can break pipes (soil formation).
- Water is the life blood of biosphere
- Water is one of our poorly Managed resources.
- We waste it and pollute it we charged too little for making it available. This encourages still greater waste and pollution of this resource, for which we have no substitute.
- Benjamnin Franklin statement "It is not until the well runs dry that we know the worth of H2O".

AVAILABILITY OF FRESH WATER:
Only a tiny fraction of the planet's abundant H2O is available to us as fresh water. About 97.4% by volume is found in the oceans and is too salty for drinking irrigation or industries. Most of remaining 2.6% that is fresh water is locked up in ice caps or glacier or in ground water too deep or salty to be used.

Thus the only about 0.014% of earth's total volume of water is easily available to us as soil Moisture, usable Ground water, water vapour, lakes and streams. If world's H2O supply were only 100L, our usable supply of fresh water would be only 0.014 litres (2.5 tea spoons)
This water is continuously collected, purified & recycled & distributed in the solar powered hydrologic cycle.
This works only as long as we do not overload water system with slowly degradable & non degradable wastes or with draw water from underground supplies faster than it is replenished.
Differences in average annual precipitation divide the world country and people into water haves and have nots.
For e.g. Canada with only 0.5% world's population has 20% of world's usable water, whereas China with 21% of world's population has only 7% of supply.
Global warming can increase global rates of evaporation, shift precipitation pattern and disrupt H_2O supplies and thus food supplies.
Ocean97.4% Fresh water2.6%
Ice caps & glaciers1.98%

Ground water 0.592% 0.014% Soil moisture 0.005%
Some areas will get more precipitation and some less, some rivers flow will change.

THE HYDROLOGIC CYCLE:

In hydrologic cycle, H_2O continuously moves from the atmosphere to the land, plants, oceans and fresh water bodies and then back into the atmosphere. It consists of number of stages.

1. The largest amount of water transferred in any segment of the total cycle is those involved in the direct evaporation from the sea to the atmosphere and in precipitation back to the sea.

Evaporation:

By which H_2O changes from liquid to the gaseous form.

Precipitation:

It includes any liquid H_2O or ice that falls to the surface through atmosphere.

2. The passage of H_2O to the atmosphere through leaf pores is called transpiration and term Evapo transpiration encompasses the process by which water evaporates from the land surface and plants. Evapotranspiration combines with the precipitation of water onto the land surface to play a quantitatively smaller, but possibly more important.

3. If surplus precipitation at the land surface does not evaporate. It is removed via the surface network of streams & rivers, a phenomenon called runoff. The runoff includes some H_2O that flows beneath the surface & eventually find its way to rivers & Oceans . It can be viewed as closed system, in which water is continuously moved among the component spheres of earth system.

Water circulates between the lower atmosphere, upper Lithosphere, the plants of the biosphere and the oceans of hydrosphere. The system can also be split into two subsystems. One consisting of the precipitation and evaporation over the oceans and the other involving evapotranspiration and precipitation over land areas. The two subsystems are linked by horizontal movement in atmosphere and by surface runoff flows.

The time required for H_2O to traverse the full cycle can be quite brief. A molecule of water can pass from ocean to the atmosphere and back again within a matter of days. Over land, cycle is less rapid. Ground water goes into soil or subsurface and can remain there for weeks (or) months. The circulation is even slower where H_2O in the solid form of ice is concerned. Some H_2O has been locked up in Major ice sheets and glaciers for many thousand years.

Surface Water:

Surface run off precipitation that does not infiltrate the ground or return to the atmosphere or return to the atmosphere by evaporation (including transpiration). This runoff flows into streams, lakes, wetlands, estuaries and reservoirs.

Watershed:

A water shed, also called a drainage basin is a region from which water drains into a stream, Lake, reservoir, wetland, estuary, or other body of surface water.

Ground Water:

Some precipitation infiltrates the ground and percolates downward through voids (pores, fractures, crevices, and other spaces) in soil and rock. The water in these voids is called groundwater.

Aquifers:

Porous, water – Saturated layers of sand, gravel, or bedrock through which groundwater flows are called Aquifers.

Use and over Utilization of fresh water:

Use of fresh water supply:

During the last century the human population tripled. According to a 2002 report by the United Nations, during this period our global water withdrawing (use) increased sevenfold and per capita withdrawal quadrupled. As a result, we now with draw about 35% of the world's reliable runoff. We lease another 20% of this runoff in streams to transport goods by boats, dilute pollution, and sustain fisheries and wildlife. Thus we directly or indirectly are already using about 55% of the worlds reliable run off of surface water. Because of increased population growth and economic development, global withdrawal rates of surface water could reach more than 70% of the reliable surface runoff by 2025 and exceed such runoff in growing number areas. Uses of withdrawn water vary from one region to another and from one country to another. Worldwide, about 69% of water withdrawn each year from rivers, lakes and aquifers is used to irrigate 17% of the world's cropland and produce about 40% of the world's food.

Industry uses about 23% of the water withdrawn each year, and cities and residences use the remaining 8% Agriculture and manufacturing use large amounts of water. Some of the water withdrawn from a source may be returned to that source of or reuse. Consumptive water use occurs when water withdrawn becomes unavailable for reuse in the basin from which it was removed – mostly because of losses such as evaporation or contamination.

FRESHWATER SHORTAGES:

According to Swedish hydrologist Malin Falkenmark, there are four causes of water scarcity i) a dry climate, ii) drought (a period of 21 days or longer in which precipitation is at least 70% lower and evaporation is higher than normal), iii) desiccation (drying of exposed soil because of such activities as deforestation and overgrazing by livestock), and iv) water stress (low per capitation availability of water caused by increasing number of people relying on limited runoff levels.

Increase Freshwater Supplies

There are several ways to increase the supply of freshwater in a particular area.

· Build dams and store reservoirs to run off for release as needed.

· To bring in surface water from another area.

· Withdraw groundwater and

· Convert salt water to fresh water (desalination).

Other strategies are to reduce water waste and import food to reduce water use in growing food. Each imported metric ton of grain saves roughly, 1,000 metric tons of water needed to produce the grains.

Advantages and Disadvantages of Large Dams and Reservoirs:

Large dams and reservoirs have benefits and drawbacks. Their main purpose is to capture and store run off and releases it as needed for controlling floods, producing hydroelectric power and supplying H_2O for irrigation and for towns and cities.

Reservoirs also provide recreational activities such as swimming, fishing and boating.

Advantages:

1. Generates electricity at cheaper rates.
2. Reduces dependence on coal.
3. Reduces air pollution.
4. Reduces CO_2 emission
5. Reduces chances of downstream flooding
6. Reduces river sitting below dam by eroded soil.
7. Increases irrigation water for cropland below dam
8. Useful for recreation and fishing.

Disadvantages:
1. Floods large areas of cropland and forests
2. Displaces people
3. Increase water pollution because of reduced water flow
4. Reduce deposits of nutrient rich sediments below dam
5. Increases salt water introduced into drinking water near mouth of river because of decreased water flow.
6. Disrupts spawning and migration of some fish below dam.
7. Modifies ecosystem and hydrologic regimes in areas both upstream and down stream.
8. Storing water create hydraulic pressure and leads to seismic tremors.
9. Structural defects in the dam, cause it to collapse suddenly and destroy many living organisms
10. High Cost.

Withdrawing Ground water

Aquifer provides drinking water for about 1/4 th of the world's people.

Advantages:
1. Good source of water for drinking and irrigation
2. Available year around
3. Exist almost everywhere
4. Renewable if not over pumped or contaminated
5. No evaporation losses.
6. Cheaper to extract than most surface water.

Disadvantages:
1. Aquifer depletion from over pumping
2. Sinking of tend when water removed
3. Polluted aquifers instable for decades or centuries
4. Salt water intrusion into drinking water supplies near coastal areas.
5. Reduced water flows into streams, lakes, estuaries and wet lands.
6. Increased cost, energy use, and contamination from deeper wells.

Ground Water Depletion:

Prevention:
1. Waste Less Water
2. Subsidize water conservation
3. Ban new wells in aquifers near surface water.
4. Buy and retire ground water withdrawal rights in critical areas.
5. Do not grow water intensive crops in dry areas
6. Reduce birth rates.

Control:
1. Raise price of water to discourage waste
2. Tax water pumped from wells near surface waters.
3. Set and enforce minimum stream flow levels.

Reducing water Waste:

World Resource Institute estimates that 65- 70% of the water people use throughout the world is
lost through evaporation, leaks and other losses.
It is economically and technically feasible to reduce such water losses to 15% thereby meeting

most of the worlds water needs for the foreseeable future.
Prevention method for reducing water in Irrigation:
1. Lining Canals bringing water to irrigation ditches
2. Irrigation at night to reduce evaporation.
3. Using soil and satellite sensors and computer systems to monitor soil moisture and add water only
when necessary.
4. Poly culture
5. Organic farming
6. Growing water efficient crops using drought resistant and salt tolerant crop varieties
7. Irrigation with treated urban waste water
8. Importing water intensive crops.
Reducing Water waste in Industries, homes and businesses:
1. Redesign manufacturing process
2. Landscape yards with plants that required little water
3. Use drip irrigation
4. Fix water Leaks
5. Use water meter and charge for all municipal water use.
6. Raise water Prices.
7. Require water conservation in water short cities.
8. Using water – saving toilets, shower heads and front loading clothes washers.
9. Collect and reuse house hold water to irrigate lawns and non edible plants.
10. Purify and reuse water for houses, apartments and office buildings.

Case Study:

The Cauvery water dispute:

Out of India's18 major rivers 17 are shared between different states. In all these cases, there are intense conflicts over these resources, which hardly seem to resolve. The Cauvery river water is bone of contention between TamilNadu and Karanataka and the fighting is almost hundred years old. TamilNadu occupying, the downstream region of the river wants water use regulated in the upstream, whereas the upstream state Karnataka refuses to do so and claims its primacy over the river as upstream user. The river water is almost fully utilized and both the states have increasing demands for agriculture and industry. On June 2, 1990 the Cauvery H_2O dispute tribunal was set up which through an interim award directed Karnataka to ensure that 205 TMCF of water was made available in Mettur every year till settlement was reached. In 1995, situation turned into crisis due to delayed rain and an expert committee was set up to look into the matter which found that there was a complex cropping pattern in Cauvery basin. Proper selection of crop varieties optimum use of H_2O better rationing, rational sharing patterns and pricing of water are suggested as some measures to solve the problems.

FOOD RESOURCES

Human have depend on three systems for their food supply. Croplands mostly produce grains and provide about 76% of the world's food. Range lands produce meat mostly from grazing live stock and supply about 17% of the world's food. Oceanic fisheries supply about 7% of the world's food. Since 1950 these has been a staggering increase in global food production from all three systems, because of technological advantages. To feed the world's 9.3 million

people projected by 2050, we must produce and equitably distribute more food than has been produced since agriculture began about 10000, years ago and do this in an environmentally sustainable manner. Other analysts contend that environmental degradation, pollution, lack of water for irrigation, overgrazing by live stock, overfishing and loss of vital ecological services may limit future food production. A key problem is that human activities continue to take over or degrade more of plants net primary productivity. The earth has perhaps 30,000 plant species with parts that people can eat. However, only 15 plant and 8 terrestrial animal species supply an estimated 90% of our global intake of calories.Just three grain crops - wheat, rice and corn - provide more than half the calories people consume. These grains are annual. Two – thirds of the world's population survives primarily on traditional grams mostly because they cannot afford meat. As incomes rise, people consume more grain, but indirectly in the form of meat, eggs, milk cheese and other products of grain eating domesticated live stock. Fish and shell fish are an important source of food for about 1 billion people in Asia & in coastal areas of developing countries. But on global scale, it supply only 7% of the world's food.

World food problems:

The Food and Agriculture Organization (FAO) of UN estimated that on an average of the minimum calorie intake on a global scale is 2500 calories/day People receiving less than 90% these minimum dietary calories are called under nourished and if it is less than 80% they are said to be seriously undernourished. Besides the minimum calorie intake we also need proteins, minerals etc. Deficiency or lack of nutrition often leads to malnutrition resulting in severe diseases. During the lost 50 years world grain production has increased almost three times, thereby increasing per capita production by about 50%. But at the same time population growth increased at such a rate in LDC (Less developed countries) that it outstripped food production.

Every year 40 million people die of undernourishment and malnutrition (fifty percent of which are young children between 1 to 5 years. 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. These startling statistical figures more than emphasize the need to increase our food production, equitably distribute it and also to control population growth.

Indian Scenario:

Although India is the third largest producer of staple crops an estimated 300 million Indians are still under nourished. India has only half as much land as USA but it has nearly three times population to feed. The World food summit, 1996 has set the target to reduce the number of under nourished to just half by 2015, which still means 410 million undernourished people or earth.

Charges caused by Agriculture:

Agriculture has significant harmful effects on air, soil, water & biodiversity. Some analyst believes these harmful environmental effects can be overcome and will not limit future food production. Other analysts disagree. The future ability to produce more food will be limited by a combination of environmental factors. They include soil erosion, desertification, salinization and water logging of irrigated land, water deficits and droughts loss of wild species that provide the genetic resources for improved forms of foods and the effects of global warming in some parts of the world. According to a 2002 study by UN Department, close to 30% of world's cropland has been degraded by sail erosion, salinity and chemical pollution and 17% has been seriously degraded.

Major Environmental effects of Agriculture:

1. Soil Problems:

a) Soil erosion

b) Loss of fertility

c) Salinization
d) Water logging
e) Desertification

2. Water Problems:
a) Aquifer depletion
b) Increased runoff and flooding from land cleared to grow crops.
c) Sediment pollution from erosion
d) Fish kills from pesticides
e) Surface & ground water pollution from pesticides and fertilizers.
f) Over fertilization of Lakes and slow moving rivers from run off of nitrates and phosphates from
fertilizer livestock wastes and food processing wastes.

3.Bio diversity loss
a) Loss and degradation of habitat from clearing grasslands and forests and draining wetlands
b) Killing of wild predators to protect stock
c) Loss of genetic diversity from replacing thousands of wild crop strains with a few mono culture strains.
4. Air pollution:
a) Green house gas emission from fossil fuel use
b) Other air pollutants from fossil fuel use
c) Pollution from pesticide sprays.
5.Human Health :
a) Nitrates in drinking water
b) Pesticide residues in drinking water food and air
c) Contamination of drinking and swimming water with disease organisms from live stock wastes.
d) Bacterial contamination of meat

Effects of over grazing:

Overgrazing can limit livestock production. Overgrazing occurs when too many animals graze for too long and exceed the carrying capacity of a grassland area. Excessive numbers of domestic livestock feeding for too long in particular area causes most overgrazing. Such overgrazing lowers the net primary productivity of grassland vegetation and reduces grass cover. It also and exposes the soil to erosion by water and wind, compacts the soil (which diminishes its capacity to hold water) and is a major cause of desertification.
Some grass land can suffer from under grazing where; absence of grazing for long periods (at least 5 years) can reduce the net primary productivity of grassland Vegetation and grass cover. Moderate growing of such areas removes accumulation of standing dead material and stimulates new biomass production.

Modern Agriculture and its impacts

It makes use of hybrid seeds of selected and single crop variety, high – tech equipment and lots of energy subsidies in the form of fertilizers, pesticides and irrigation water.
i) Impact related to high yielding varieties (HYV). The uses high yielding varieties (HYV) encourage monoculture. Incase 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 disease.

ii) Fertilizer related Problems

a) Micronutrient imbalance:

Excessive use of fertilizers cause micronutrient imbalance. For e.g. excessive fertilizer use in Punjab and Haryana has caused deficiency of the Micronutrient Zinc in the soils, which is affecting productivity of the soil.

b) Nitrate Pollution:

Nitrogenous fertilizers applied in the field often reach deep into the soil and ultimately contaminate the ground water. When their concentration exceeds 25 mg /l, they become the cause of a serious health hazard called blue baby syndrome or methaemoglobinemia and cause death in infants.

c. Eutrophication:

Excessive use of nitrogen and Phosphate fertilizers in the agricultural fields leads to another problem (eutrophication). A large proportion of N and P used in crop fields is washed off along with run off water reach the water bodies causing over nourishment of the lakes a process known as Eutrophication. Due to eutrophication the lakes get invaded by algal blooms. They are toxic & badly affect the food chain. The algal species quickly complete there life cycle and die thereby adding a lot of dead organic matter. The fishes are also killed. Oxygen is consumed in the process of decomposition and very soon the water gets depleted of dissolved oxygen. This causes an anaerobic condition where, pathogenic anaerobic bacteria can survive.

iii) 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 pest. DDT belongs to second generation pesticide. After 1940, a large number of synthetic pesticides came into use. Although these pesticides have gone a long way in protecting our crops from huge losses occurring due to pests, yet they have a number of side effects as discussed below.

a. Creating resistance in Pests and producing new pests:

Some individuals of pest species usually survive even after Pesticides spray. The survivors give rise to highly resistant generation. Pests which have become immune to all types of Pesticides are known as super pests.

b. Death of non target organism:

Many insecticides are broad spectrum poisons which not only kill the target species but also several non target species that are useful to us.

c. Biological Magnification:

Many of Pesticides are non bio degradable and keep on accumulating in the food chain a process called biological magnification

Salinity:

Approximately 17% of the world's cropland that is irrigated produces almost 40% of the world's food. Irrigated land can produce crop yields two or three times greater than those from rain watering. But irrigation has a downside. Most irrigation water is a dilute solution of various salts, picked up as the water flows over or through soil and rocks. Small quantities of these salts are essential nutrients for plants, but they are toxic in large amounts.Irrigation water not absorbed into the soil evaporates leaving behind a thin crust of dissolved salts in the top soil. This accumulation of salts is called salinization, which stunts crop growth, lowers crop yields and eventually kills plants and ruins the land.According to a 1995 study, severe salinization has reduced yields on 21% of the world's irrigated cropland and another

30% has been moderately salinized. The most severe salinization occurs in Asia especially in china, India, and Pakistan.

Water Logging:

Farmers often apply large amounts of irrigation water to leach salts deeper into the soil. Without adequate drainage, however water accumulates underground and gradually raises the water table. Saline water then envelops the deep roots of plants, lowering their productivity and killing them after prolonged exposure. At least one - tenth of all irrigated land world wide suffers from water logging and the problems is getting worse. Under water logged conditions pore spaces in the soil get fully drenched with water and soil air gets depleted. Water table rises while the roots of plants do not get adequate air for respiration Mechanical strength of the soil declines, crop plants get lodged and crop yield falls.

Soil Salinization:

Prevention:

1. Reduce irrigation
2. Switch to salt tolerant crops such as (barley, cotton, sugar beet)

Control

1. Flushing soil (expensive and wastes water)
2. Not growing crops for 2- 5 years
3. Installing underground drainage system (expensive)

Salinity and water logging in Punjab, Haryana and Rajasthan:

The first alarming report of salt – affected wasteland formation in connection with irrigation practices came from Haryana (then Punjab) in 1858. It was reported that several villages in Panipat, Rohtak and Delhi lying in command area of western Yamuna Canal were suffering from destructive saline efflorescence. The "Reh Committee" in 1886 draw the attention of the government on some vital points showing a close relationship between irrigation, drainage and spread of "reh" and " usar" soils.

The foods of 1947, 1950, 1952, 1954 – 56 in Punjab resulted in aggravated water logging with serious drainage problems introduction of canal irrigation in 1.2 m ha in Haryana resulted in rise in water – table followed by water – logging and salinity in many irrigated areas causing huge economic losses as a result of fall in crop productivity. Rajasthan too has suffered badly in this regard following the biggest irrigation project " Indira Gandhi Canal Project" and the suffering of a big area in western Rajasthan have changed from a condition of " water – starved wasteland" to that of a "water – soaked wasteland".

ENERGY RESOURCES

Energy is capacity to do work. Energy resources are classified into renewable energy resources and non renewable energy resources. Non renewable energy resources are finite and cannot be replaced after being used.

E.g. fossil fuel, natural gas etc

Renewable energy resources

Renewable energy resources are indefinitely renewable or naturally replenished after being used by man and are not likely to be exhausted by man's use E.g. Sunlight, wind, tide, biomass etc.

Non Renewable energy resources

Main sources of energy in the industrialized world are fossil fuel and Mineral fuels
Carbon containing natural resources- include solid (coal), liquid (Petrol) and gas (Natural gas) fuel.
Formed from fossilised remains of pre historic plants and animals
Coal
- most common source of energy
- 60% of commercial energy consumption is met by coal
- Indian stands 5th place.
- Different types of coal Anthracite (high quanlity coal, high heat content) Bituminous, high heat content as well as high sulphur content) lignite (low heat content) peat (low heat content)
- Coal is Pollutant, when burnt it produces CO_2 and CO

Petroleum:
- Most important component of commercial energy 40% energy fed by Petroleum
- High heat content
- Burns without ash or smoke.
- Produce Pollutants such as sulphur oxides CO, Lead etc.

Natural gas:
- an alternative substitute for oil
- It is one of the cleanest fossil fuel
- It burns completely leaving no ash or smoke
- High heat content.
- Transportation of gas cost is high
- Large reserves are estimated to be located in inaccessible areas.

Renewable energy Sources:

(Non‐ Conventional energy source) Can be renewed again and again either by fostering their growth with efficient management or they may be available in nature permanently without depletion.

Non‐ Conventional energy: to conserve conventional energy resource and to meet the energy crisis, efforts were made for developing new sources of energy. These are called non ‐ conventional energy sources.

E.g. Solar, wind, tidal, biogas & geothermal

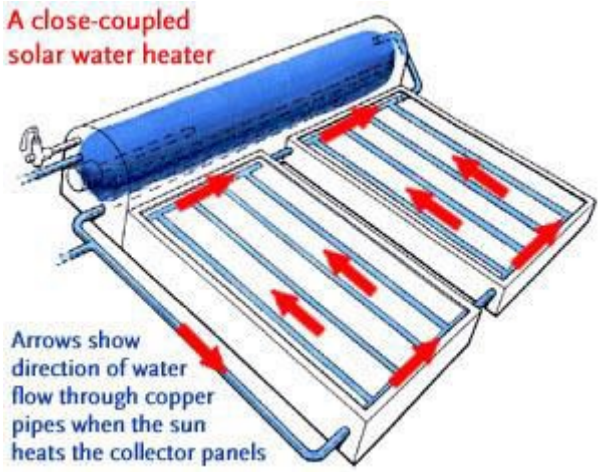
Growing energy needs:

Development in different sectors relies largely upon energy. Agriculture, Industry mining, transportation, lighting, cooling & heating in buildings all need energy. With demands of growing population the world is facing further energy deficit. Fossil fuels at present are supplying 95% of the commercial energy of the world resources.Developed countries like U.S.A. & Canada constitute about 5% of the world's population, but consume one fourth of global energy resources.An average person there Ethiopia, Nepal & Bhutan consumes less than 1 GJ in a year. Our life style and standards of living are closely related to energy needs.

Alternate energy sources:

Solar energy:

A solar collector is basically a flat box and are composed of three main parts, a transparent cover, tubes which carry a coolant and an insulated back plate. The solar collector works on the green house effect principle; solar radiation incident upon the transparent surface of the solar collector is transmitted through though this surface. The inside of the solar collector is usually evacuated, the energy contained within the solar collect is basically trapped and thus heats the coolant contained within the tubes. The tubes are usually made from copper, and the backplate is painted black to help absorb solar radiation. The solar collector is usually insulated to avoid heat losses.



Active solar water heating

The main components on an active solar water heating system are

· Solar collector to capture the suns energy and to transfer is to the coolant medium

· A circulation system that moves the fluid between the solar collector and the storage tank

· Storage tank

· Back up heating system

· Control system to regulate the system operation

The two main types of solar water heating systems are the closed loop system and the open loop system.

The open loop system used water as the coolant, the water circulates between the solar collector and the storage tank.

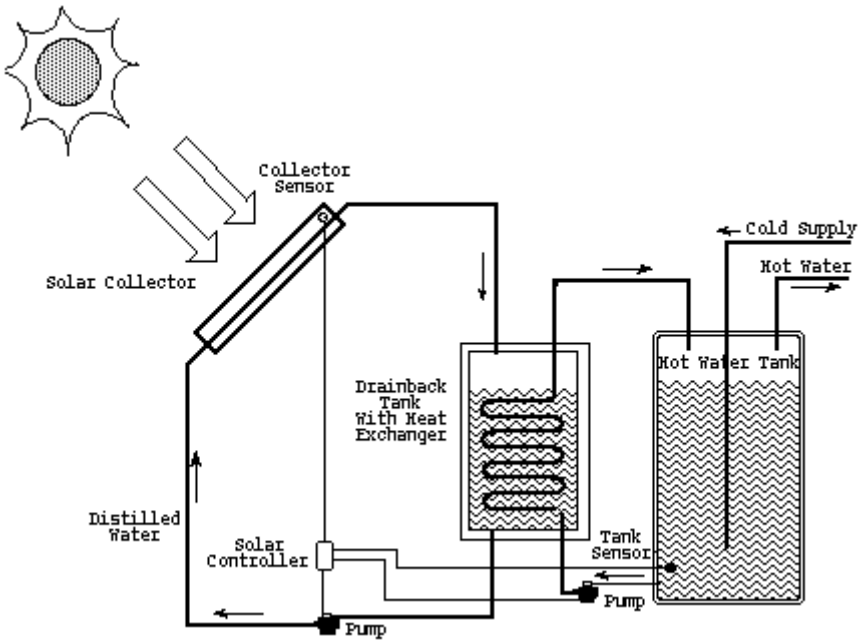
There are two main types of open loop system these are the draindown system and the recirculating system, the main principle behind both systems is the activation of circulation from the collector to the storage tank when the temperature within the solar collector reaches a certain value.

In the drain down system a valve is used to allow the solar collector to fill with water when the collector reaches a certain temperature.

In the recirculating system water is pumped through the collector when the temperature in the storage tank reaches a certain critical value.

In applications where there is likely to be a temperature drop below zero degrees then it is necessary to use a closed loop system. The main difference between the open loop system is the water is replaced with a coolant which will not freeze in the temperature range which the solar collector may be subject to. The coolant will usually be refrigerant, oil or distilled water.

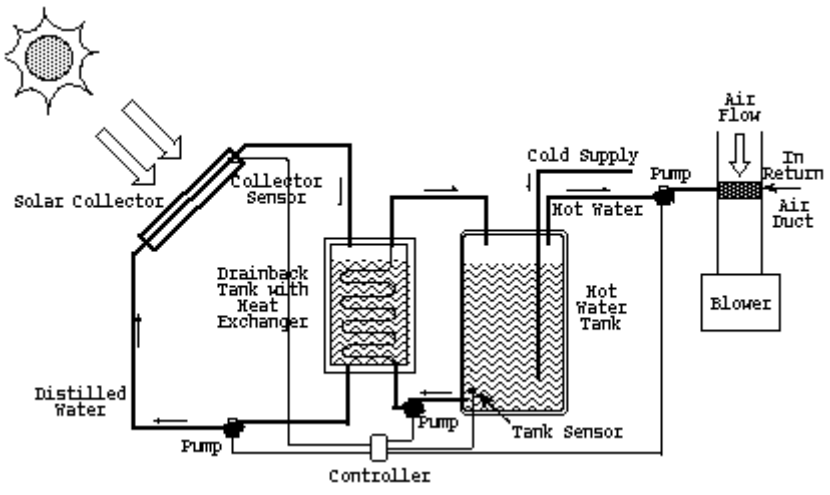
Closed loop systems are generally more costly than their open loop counter parts and great care must be taken to avoid contamination of the water with refrigerant. The energy captured by the coolant is then transferred to the hot water via a heat exchanger. In a drainback system the coolant may be distilled water. The system works on the principle that there is only water in the collector when the pump is operating. This has the benefit that the coolant used in the system will not have the chance to cool down during the night when temperature may drop to a level which may cause the coolant to increase in density and thus perhaps cause is not be as free flowing as it should. The only necessary feature on the drainback system is that the solar collectors are elevated from the heat exchanger or drainbak tank in order for the coolant to flow out of the collector. This system again works on the principle that the water is circulated between the collector and the drainback tank when the designated temperature is reached between the solar collector and the hot water.



Active solar space heating

The system components in a space heating application are the same for water heating with the addition of radiators for space heating or under floor heating coils or even forced air systems. A radiator system will generally work in a very similar manner to the hot water application, the main difference is the inclusion of a boiler, heated water from the collector is passed through the heat exchanger or drainback tank and is then passed to a boiler with is used to supplement the water hearing requirements before passing into the radiators to be used for space heating.

Air distribution systems.

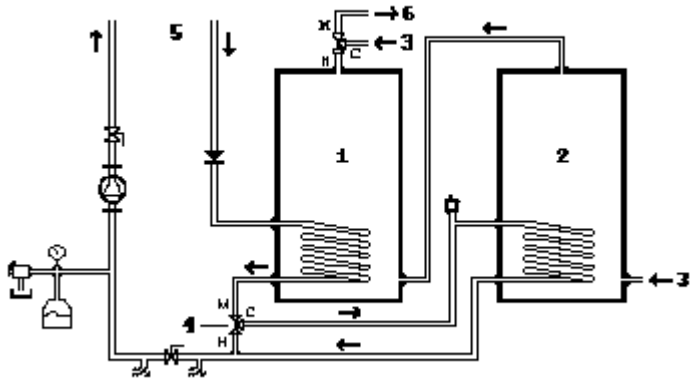


Again the air distribution system works in a manor very similar to the hot water system, the main difference is the inclusion of a blower and an air duct. The system uses an additional controlled which will allow air flow over the coil when the temperature in the storage tank is high enough that passing air over the coils in the return duct of the apparatus will allow the system to make a positive contribution to the heating space heating demand.

In large commercial or industrial applications system design is slightly different from residential applications. It is worth noting that the temperature rise across a collector is fairly

constant to use an example if the temperature of supply to the collector is around 60°F and the temperature of return is around 73oC or the return is 173°F and the supply is 160°C, this basically means that high and low temperature applications should not be put in series inside a loop. The low temperature application would basically drag down the higher temperature application. Vacuum collectors are excellent performers in high temperature applications the collector loop should be dedicated to the higher temperature application
until the load is satisfied. In applications such as for hospitals, hotels or commercial office blocks are may be necessary for the installation of two or more tanks connected in series.

1. storage tank 2. preheat tank 3. cold feed 4.mixing valve 5. supply and return to collector 6. hot water out system



system operation: Hot water from the collector passes through the coil in tank one (**1**), Then, depending on it's temperature, it is diverted by a three way valve **(4)** to either: the coil in tank **(2)** if it is above the set temperature, (meaning tank **(1)** is hot) or the collector, if it is below the set temperature of the mixing valve.
Commercial and industrial design considerations: The system can be expanded to include more than one preheat tanks, the heat exchange coils are linked by three way valves and the water which is to be heated runs in series through the tanks in the opposite direction. The three way valve can either be thermally controlled or electrically operated. No more than 100 tubes should be plumbed in series. Care must be taken when designing the pipe work in each section to ensure that each section receives equal flow.
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Solar energy to generate high temperature, heat and electricity

Solar thermal systems collect and transform radiant energy from the sun into high temperature thermal energy, which can be used directly or converted to electricity.

1. Central receiver system – Power tower

Huge arrays of computer controlled mirrors called heliostats track the sun & focus sunlight on a central heat collection tower.

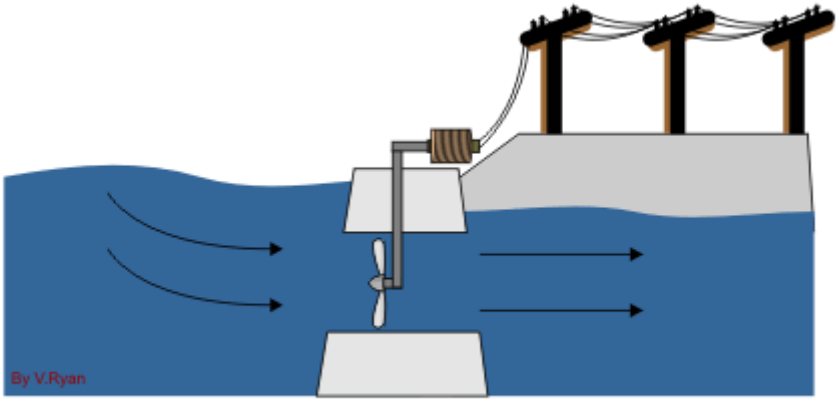
2. Distributed receiver system, in which sunlight is collected and focused on oil filled pipes running through the middle of curved solar collectors. This concentrated sunlight can generate temperature high enough for industrial process or for producing steam to run turbines and generate electricity.
3. A different type of distributed receiver system uses parabolic dish collectors instead of troughs. These collectors can track sun along two axes and are more efficient than troughs.

Solar cookers:
Concentrate sunlight and cook food. They can be made by fitting an insulated box big enough to hold three or four pots with a transparent, removable top.

Solar Cells:
Solar energy can be converted directly into electrical energy by photovoltaic cells (PV cells) solar cells. It is a transparent wafer containing a semi conductor material. Sunlight energizer and causes an electron in the semi conductor to flow creating a current. A single cell produces only tiny amount of energy. Thus many cells are wired together in modular panels to produce the amount of electricity needed.

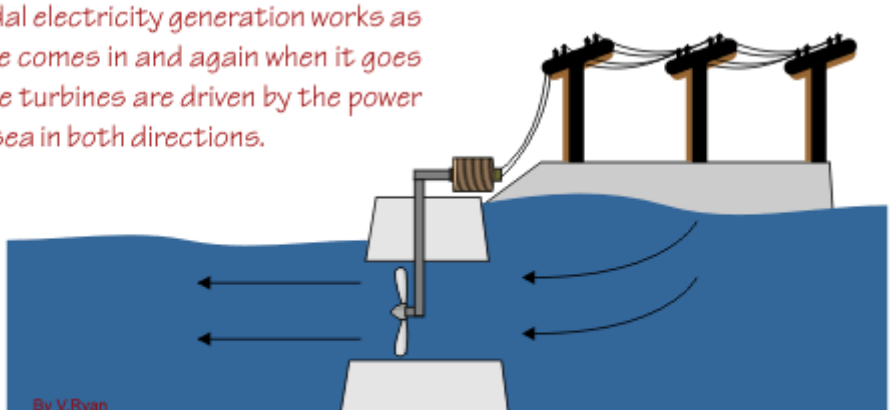
Large scale hydro power:
High dam is built across large river to create a reservoir. Some of the water stored in the reservoir is allowed to flow through huge pipes at controlled rates, spinning turbines and producing electricity.

Small scale hydro power:
Low dam with no reservoir is built across a small stream and the streams flow of water is used to spin turbines and produce electricity.



TIDE COMING IN

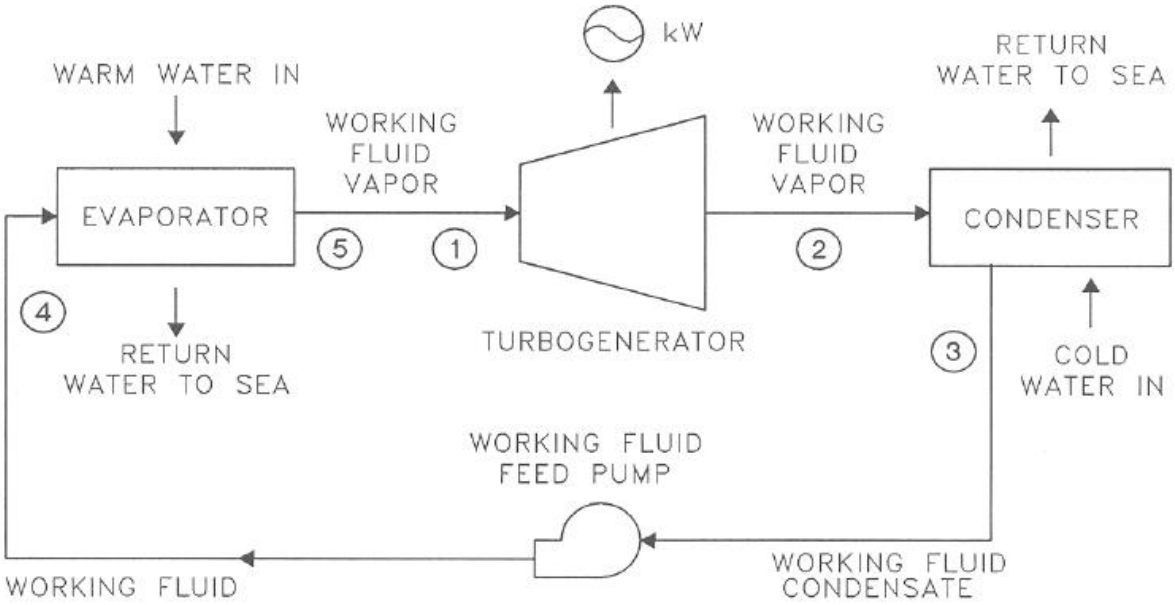
This tidal electricity generation works as the tide comes in and again when it goes out. The turbines are driven by the power of the sea in both directions.



Tidal energy:
Twice a day in high and low tides, water that flows into and out of coastal bays and estuaries can spin turbines to produce electricity.

Wave energy:
The kinetic energy in Ocean waves created primarily by wind is another potential source of electricity.

Ocean Thermal energy conversion
The large temperature difference between the cold water and sun warmed surface water of tropical oceans are used for producing electricity.



Wind Energy:

The high speed winds have lot of energy in them as KE due to their motion. The driving force of the wind is sum. It is harnessed by wind mills.The blades of windmill keep on rotating continuously due to the force of the striking wind. The rotational motor of blade drives a number of machines like water pumps, flour mills and generator. Ideal location is coastal region, open grass lands or hilly regions, particularly mountain passes where the winds are strong and steady. The wind power potential in our country is estimated to be 20000 MW, while at present we are generating of about 1020 MW.

Geo thermal energy:

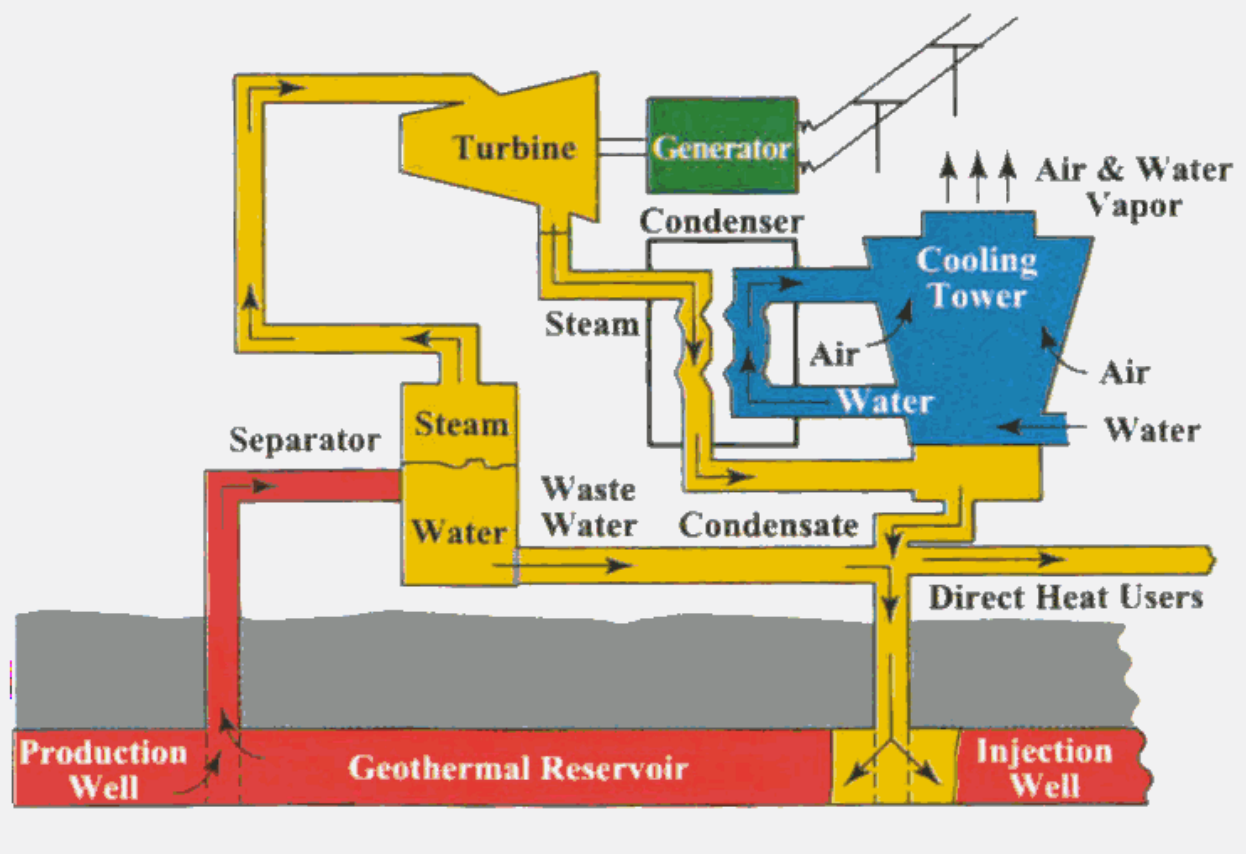
Heat contained in underground rocks & fluid is a source of energy.

Geothermal energy from earth's mantle has been transferred to three types of underground reservoirs.

1. Dry steam which consists of steam with no water droplets
2. Wet stream consists of a mixture of steam & H_2Odroplets.
3. Hot water trapped in fractured or porous rock at various places in the earth's crust.

If such sites are close to surface, wells can be drilled to extract the dry / wet stream or hot water.

This energy can be used to heat homes buildings and to produce electricity.

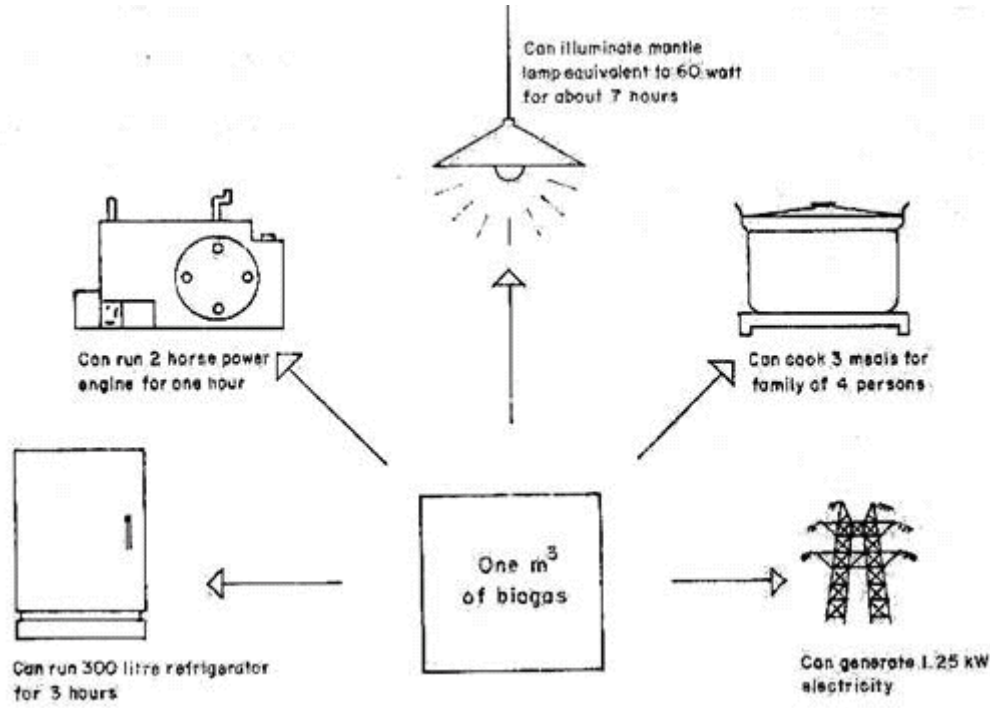


Hydrogen fuel:
When H_2 burns in air, it combines with O_2 gas in the air and produces non polluting H_2O
$2H_2 + O_2$ ® $2H_2O$
Wide spread use of this fuel would eliminate most of air pollution problem.
It reduces the threat from global warming by enacting noCO_2
H_2 is produced by electrolysis of water
H_2 is produced in high temperature or by chemical processes.
Photolysis of Water:
Decomposition of sewage and wet bio mass produce H_2.

Energy from Biomass:
Biomass consists of plant materials and animal wastes used as sources of energy.
It can be burned directly as a solid fuel or converted into gaseous or liquid biofuels.
- One way to produce biomass fuel is to plant, harvest and burn large numbers of fast growing trees (Cotton wood, poplar, willows, leucaenas) (biomass plantation)
- In agricultural areas, crop residues and animal manure can be collected and burned or converted to biofuels.

Bio gas
Mixture of 60% CH_4, & 40% CO_2
Bacteria and various chemical processes can convert some forms of biomass into gaseous and liquid biofuels.
Biogas digesters convert plant and animal wastes into methane fuel for heating and cooking.
These simple devices can be built for about $ 50 including labour.
After biogas has been separated, solid residue is used as fertilizer.
Ethanol can be made from sugar and grain crops by fermentation and distillation.

Methanol is produced from wood, wood wastes agricultural wastes, sewage, garbage and coal.



Bio gas:
Mixture of methane, carbondioxide and hydrogen sulphide. Methane is the major constituent. It is obtained by anerobic fermentation of animal dung (or) plant wastes in the presence of water.

Gasohol:
Mixture of ethanol and gasoline India trial is going on to use gasohol in cars and buses.

Hydrogen fuel:
Hydrogen produced by pyrolysis, photolysis and electrolysis of water. It has high calorific value.
Non polluting one because the combustion product is water.

Disadvantages:
1.Hydrogen is highly inflammable and explosive.
2.Safe handling is required.
3.Difficult to store and transport.
Non renewable energy sources:
Energy which can not be regenerated.

Coal:
It is a solid fossil fuel.

Disadvantages:
1.when coal is burnt large amount of CO_2 is released. Which causes global warming.
2.S, N produces toxic gases during burning.

Petroleum:
Crude oil is a liquid consists of more than hundreds of hydrocarbons and small amount of impurities. The petroleum can be refined by fractional distillation. In the world level 25% of oil reserves are in Saudi Arabia. At present rate of usage, the world crude oil reserves are expected to get exhausted in just 40 years.

Liquefied petroleum gases(LPG):
Petroleum gases obtained during FD and cracking can be easily converted into liquid under high pressure as LPG. It is colourless and odourless gas, but during cylindering mercaptans are added to detect leakage.

Natural gas:
These are found above oil in oil wells. It is a mixture of methane and other hydrocarbons. Calorific value is high. There are two types. Dry gas and wet gas.

Nuclear energy:
Dr.H.Bhabha is a father of nuclear power development in India. 10 nuclear reactors are present in India. It produces 2% of India's electricity. Nuclear energy can be produced by two types of reactions.

Nuclear fission and nuclear fusion.

Nuclear fission:
It is a nuclear change in which heavier nucleus split into lighter nuclei on bombardment of fast moving neutrons. Large amount of energy is released through chain reaction.
E.g
Uranium with fast moving neutron gives barium and krypton in addition to three neutrons, in the second stage it gives nine neutrons and so on. This process of propagation of the reaction by multiplication is called chain reaction.

Nuclear fission:
It is a nuclear change in which lighter nucleus are combined together at extremely high temperature (1 billion 0C) to form heavier nucleus and a large amount of energy is released.
E.g
Isotopes of hydrogen combine to form helium molecule.Case Study:

Wind energy in India:
India generating 1200 MW electricity using the wind energy. Largest wind farm situated near Kanyakumari in Tamil nadu. It produces 380 MW electricity.

Hydrogen fuel car:
General motar company of china discovered a experimental car (fuel H_2) can produce no emission only water droplets and vapours come out of the exhaust pipe. This car will be commercially available by 2010.

LAND RESOURCES

Land as a Resource:

Land is a finite and valuable resource upon which we depend for our food, fibre and fuel wood,the basic amenities of life. Soil, especially the top soil, is classified as renewable resources because it is continuously regenerated by natural process through at a very slow rate. About 200 – 1000 years are needed for the formation of one inch or 2.5 cm soil, depending upon the climate and the soil type. But, when rate of erosion is faster than rate of renewal, then the soil becomes a non renewable resource.

Land Degradation:

With increasing population growth the demands for arable land for producing food, fibers and fuel wood is also increasing. Hence, there is more and more pressure on the limited land resources which are getting degraded due to over – exploitation. Soil degradation is a real cause of alarm because soil formation is an extremely slow process as discussed above and the average annual erosion rate is 20 – 100 times more than the renewal rate.

Factors responsible for land degradation:

1.**Soil Erosion:**

The literal meaning of 'soil erosion' is wearing away of soil. Soil erosion is defined as the movement of soil components, especially surface – litter and top soil from one place to another soil erosion results in the loss of fertility because it is the top soil layer which is fertile.

2. **Soil pollution:**

Application of chemicals in the form of fertilizers, pesticides, herbicides and insecticides into the field for getting more agricultural production creates soil pollution.

3. **Salinization and water logging**

Poor irrigation practices saturate land with salts and reduce the fertility. Excessive usage of water for agriculture and flooding create water logging problems.

4. **Shifting cultivation:**

In the recent time, due to exploding population, more and more agricultural land is being sacrificed for housing. This poses great threat to soil fertility and food production.

5. **Desertification:**

Soil erosion creates infertility of soil and leads to loss in soil productivity and formation of deserts.

6. **Urbanization:**

Because of urbanization, grasslands, croplands and forests are affected. Fertile and productive land deteriorates due to developmental activities such as human settlement, industries, roads, railways, airports, dams etc.

7. **Continuous irrigation:**

Sowing crops without fertilizers season after season drains the soil of its lifeblood nutrients.

Methods of Controlling land degradation:

« Afforestation: Controls the land degradation

« Reforestation: Replanting forests at places where they were destroyed by overgrazing, excessive felling, forest fires, etc.

« Desertification can be checked by planting several rows of trees at right angles to the prevailing wind direction

« Better agricultural practices.

1) Terracing: The sloppy agricultural drainage land can be divided into a number of small distinct fields.

2) Regular cultivation: To reduce land degradation the fields should not be left bare and there should be regular cultivation.
3) Rotation of Crop: Sowing of different crops in the same field in the regular sequence for a number of years.
4) Fallowing: Ploughing the field extensively and then leaving them without sowing for a year or two by this way, aeration, texture and fertility of soil can be improved

Man induced landslides:

Movement of earthy material from higher region to lower region through a certain plane is called lands lids. The occurrence of lands slide is particularly common in geodynamically sensitive belts, the mountain regions.

Following human activities induces the land slide

« Cutting and deep excavations on slopes for buildings, roads, canals and mining activities trigger mass ‑ movement.

« The addition on the slopes like dumping of debris or wastes and the construction of heavy structures increase the chances of landslides.

« Due to transport movements in the unstable sloppy regions, landslides occur. « Underground mining activities may cause subsidence of the ground.

« Removing of vegetation in the sloppy area creates soil erosion and leads to landslides.

Soil Erosion:

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

Causes of soil erosion:

The mountain ranges are prone to erosion caused by heavy rains that strip topsoil from steep slopes.
Grazing of cattle over vegetal carpet not only damages the forest, but the soil as well.
Deforestation is another reason by which the soil gets eroded easily.
Land slide produces soil erosion.
Wind erosion, carrying away finer particles and creates soil erosion.
Because of the tidal and wave action, varying degrees of erosion is taking place along the coastal regions.
The construction of roads disturbs the stability of the hillside, removes the protective vegetal cover and leads to soil erosion.

Controlling measures of soil erosion:

« It is very important to prepare erodibility maps to control soil erosion.

« Soil loss can be avoided by covering the watershed with vegetation.

« Soil conservation can be achieved by constructing a series of check dams in the watershed area.

« Channel beds and sides can be protected by introducing vegetation.

« In deserts, the movement of the sand can be effectively arrested by building wind breakers.

« Further application of chemicals, asphalt and rubber solutions stabilize the surface of the dunes.

« Along the coasts, groynes have proved very effective in controlling erosion and building up beaches.

« Fetties are massive structures, constructed along the channels of estuaries and lagoons for retarding erosion.

Desertification:

The loss of productivity of soil as a consequence of degradation or pervasive dryness called Desertification.

Climate is one of the most important factor in the development of desertic conditions the abuse of land and over - exploitation of vegetal and water resources are primarily responsible for the expansion of desert of aggravation of desertic conditions Measures to combat desertification.

1. Desertification hazard map:

The first step in this process is the preparation of a desertification hazard map.

2. Change in grazing practices:

Livestock should not be allowed to graze freely. The cattle should be protected but permitted to graze only in the specially fenced reserves.

3. Stabilizing active dunes:

To prevent wind erosion a cover of grasses, shrubs and trees having deep roots may be grown

4. Construction of wind breaks or shelters - belts in the wind ward side of the settlements and agricultural farms reduce the velocity of winds and check the advancement of the dunes.

5. Spray of asphalt mulch and spread of jute nettings on the dunes is another protective measure for desertification.

6. The practice of Rain water Harvesting is useful solution for water scarcity problem in desert regions.

Consequences of Desertification:

« Reduction of agricultural land, cattle and vegetal productivity

« Loss of fertility and causes soil salinity.

« Uncontrolled water losses by evaporation.

« Worsens drought and famine

« Economic Losses.

« Creates lower living standard of the people and environmental refuges.

CONSERVATION OF NATURAL RESOURCES

ROLE OF AN INDIVINDUAL

Different natural resources like forests, water, soil food, mineral and energy resources play a vital role in the development of a nation. However, overuse of these resources in our modern society is resulting in fast depletion of these resources and several related problems. If we want our mankind to flourish there is a strong need to conserve these natural resources. Environment belongs to each one of us and all of us have a responsibility to contribute towards its conservation and protection. With our small individual efforts we can together help in conserving our natural resources to a large extent. Let us see how individuals can help in conservation of different resources.

CONSERVE WATER:

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

« In washing machines fill the machine only to the level required for your clothes. « Install water saving toilets (6 litres per flush)

« Check for water leaks and repair etc.

« Re use the soapy water of washings from clothes for washing off courtyards, drive ways etc.

« Water the plants in evening when evaporation losses are minimum.

« Use drip and sprinkling irrigation to improve its efficiency and reduce evaporation.

« Install a small system to capture rain water and collect normally wasted used water from sinks, clothe ‑ washers, bath tubs etc which can be used for watering the plants.

« Build Rain water harvesting system.

PROTECT THE SOIL:

While constructing house, don't uproot the trees as far as possible. Plant disturbed areas with fast growing native covers.

« Grow grass in open area which will bind the soil and prevent its erosion.

« Donor irrigate the plants using a strong flow of water as it would wash off the soil

« Better use sprinkling irrigation.

« Use green manure and mulch in the garden and kitchen garden which will protect the soil.

« Use mixed cropping so that specific soil nutrients do not get depleted.

« Do not over irrigate your fields without proper drainage to prevent water logging and salinisation.

PROMOTE SUSTAINABLE AGRICULTURE

« Do not waste food. Take as much as you can eat.

« Reduce the use of pesticides

« Fertilize the soil with organic fertilizers

« Use drip irrigation.

« Eat local & Seasonable vegetation. This saves tot of energy on transport storage and preservation.

« Control pests by a combination of cultivation and biological control methods.

« Do not use endangered species products

RESPONSIBLE CONSUMERISM:

« Practice living simply

« Recycle or Reuse the materials

« Encourage ecofriendly products

« Buy organic food

« Buy locally grown and made item

« Invest green business.

« Before buying costly items think twice environmental impacts and yours need.

CONSERVE ENERGY:

« Use stair instead of elevators

« Use public transportation, walk or ride a bicycle.

« Turn off lights, fans and other appliances when not in use

« Use solar cooker, solar heater,

« Plants trees around the building to make Cool so that it will cut off your electricity charges.

« Add more insulation to your house

« Recycle and Reuse, glass, metals and paper

« Buy always locally made long testing materials.

REDUCING WASTE:

« Buy foods that come with less packaging

« Take some container / bag from home to market for purchase.

« Better to take your own washable, refillable beverage containers to meetings and functions.

« Prefer to buy item which can be recyclable / revisable

« Buy environmentally degradable products.

« Separate at source the plastic papers, glass for recycling

« Compost all garden wastes & Vegetable wastes.

« Support government, which will be interested in environmental conservation.

LOWERING YOUR FOREST IMPACTS

« Reuse & Recycle paper

« Make double sided copies

« Use email

« Avoid using timber and plywood

« Encourage sustainably harvested wood.

« Encourage minor forest produce items on which tribal people depend.

EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFESTYLES

Scarcity of resources is the burning problem of modern technology. The twenty-first century will see growing human needs for resources since many parts of the world are using natural resources at a rate faster than the natural processes can replenish it.

Natural resources are limited. For example, the existing water sources are being subjected to heavy pollution. Global climatic changes are altering the quality of fresh water sources as a consequence of unknown effects on the hydrological cycle.

Sustainable development is currently being discussed as a focal theme in the field of development, planning and other associated aspects. In the light of self-defeating current mode of development and recurrent natural calamities, people are urged to ponder over the faults, shortcomings, lacunae, discrepancies and limitations of the ongoing developmental process and production system.

It is essential to sustain the natural resources. We should conserve natural resources so that it may yield sustainable benefit to the present generation while maintaining its potential to meet the needs of the future generation. There are three specific objectives to conserve living resources:

1.To ensure that any utilisation of the ecosystem is sustainable.

2.To preserve biodiversity and

3.To maintain essential ecological processes.

Resource management should be less energy-intensive, suitable to local ecology and needs of the people, less cost-intensive and more viable in terms of economy, ecology and culture. The Srilankan team, for example studied traditional paddy irrigation systems as a model for water management.

Its reports note that from the 5th century B.C. through the 12th century A.D., Sri Lanka developed a technologically advanced civilization based on an intricate system of rainwater conservation and irrigation. Water users were collectively and individually responsible for maintenance of the irrigation systems and customary laws, known as Sirit, were established governing water use and related aspects of life.

Similarly, the italics system is a system of farmer-managed canal irrigation, which has been in operation for more than 300 years in Dhule, and Nasik district of northwestern Maharashtra.

§ Most developed countries like USA, Canada, Japan, Australia have 22% of natural resources, use 88%.73%of its energy and command 85%of its income
§ Less developed countries has 78% of population, 12% Usage of natural resources, 27% of energy, 15% of income
§ Gap arises due to increase in population distribution of resources and wealth
§ Problem solved by equitable distribution of resources and wealth
§ Global consensus has to be reached for more balanced distribution of basic resources like safe drinking water, food, fuel etc. So poor low developed countries able to sustain their life
§ Two basic cause of unsustainability are over population in poor countries and over consumption of resources by rich countries generate wastes

§ Rich countries lower down their consumption level
§ Poor countries fulfilled by providing them resources

INTRODUCTION TO ENVIRONMENTAL BIOCHEMISTRY

The elimination of a wide range of pollutants and wastes from the environment is an absolute requirement to promote a sustainable development of our society with low environmental impact. Biological processes play a major role in the removal of contaminants and they take advantage of the astonishing catabolic versatility of microorganisms to degrade or convert such compounds. New methodological breakthroughs in sequencing, genomics, proteomics, bioinformatics and imaging are producing vast amounts of information.

In the field of environmental microbiology, genome-based global studies open a new era providing unprecedented *in silico* views of metabolic and regulatory networks, as well as clues to the evolution of degradation pathways and to the molecular adaptation strategies to changing environmental conditions. Functional genomic and metagenomic approaches are increasing our understanding of the relative importance of different pathways and regulatory networks to carbon flux in particular environments and for particular compounds and they will certainly accelerate the development of bioremediation technologies and biotransformation processes.

Microorganisms , like all living things, **require food for growth** . Biological sewage treatment consists of a step-by-step, continuous, sequenced attack on the organic compounds found in wastewater and upon which the microbes feed.

PROTEINS –BIOCHEMICAL DEGRADATION OF POLLUTANTS

Aerobic biodegradation of pollutants

Aerobic digestion of waste is the natural biological degradation and purification process in which bacteria that thrive in oxygen-rich environments break down and digest the waste. During oxidation process, pollutants are broken down into carbon dioxide (CO_2), water (H_2O), nitrates, sulphates and biomass (microorganisms). By operating the oxygen supply withaerators, the process can be significantly accelerated. Of all the biological treatment methods, aerobic digestion is the most widespread process that is used throughout the world.

Biological and chemical oxygen demand

Aerobic bacteria demand oxygen to decompose dissolved pollutants. Large amounts of pollutants require large quantities of bacteria; therefore the demand for oxygen will be high.

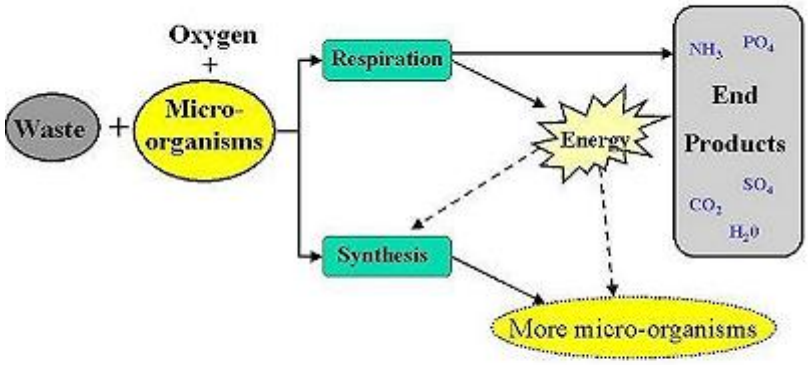
The Biological Oxygen Demand (BOD) is a measure of the quantity of dissolved organic pollutants that can be removed in biological oxidation by the bacteria. It is expressed in **mg/l.**

The Chemical Oxygen Demand (COD) measures the quantity of dissolved organic pollutants than can be removed in chemical oxidation, by adding strong acids. It is expressed in **mg/l.**

The **BOD/COD** gives an indication of the fraction of pollutants in the wastewater that is biodegradable.

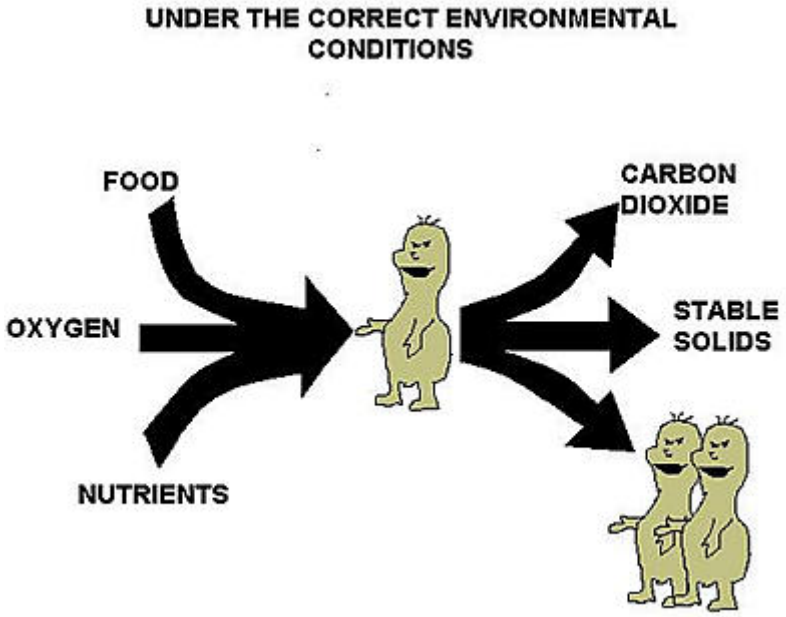
Advantages of Aerobic Digestion

Aerobic bacteria are very efficient in breaking down waste products. The result of this is; aerobic treatment usually yields better effluent quality that that obtained in anaerobic processes. The aerobic pathway also releases a substantial amount of energy. A portion is used by the microorganisms for synthesis and growth of new microorganisms.



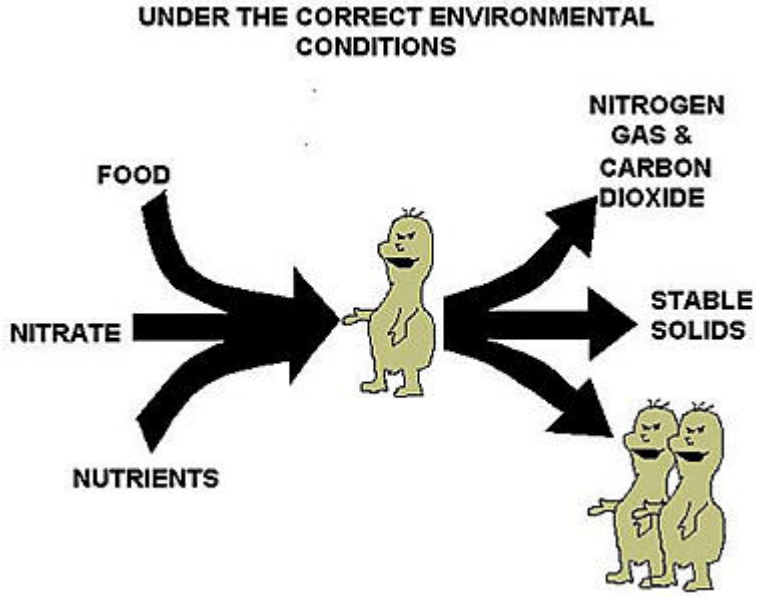
Aerobic Decomposition

A biological process, in which, organisms use available organic matter to support biological activity. The process uses organic matter, nutrients, and dissolved oxygen, and produces stable solids, carbon dioxide, and more organisms. The microorganisms which can only survive in aerobic conditions are known as aerobic organisms. In sewer lines the sewage becomes anoxic if left for a few hours and becomes anaerobic if left for more than 1 1/2 days. Anoxic organisms work well with aerobic and anaerobic organisms. Facultative and anoxic are basically the same concept.



Anoxic **Decomposition**

A biological process in which a certain group of microorganisms use chemically combined oxygen such as that found in nitrite and nitrate. These organisms consume organic matter to support life functions. They use organic matter, combined oxygen from nitrate, and nutrients to produce nitrogen gas, carbon dioxide, stable solids and more organisms.



Anaerobic Digestion

Anaerobic digestion is a complex biochemical reaction carried out in a number of steps by several types of microorganisms that require little or no oxygen to live. During this process, a gas that is mainly composed of methane and carbon dioxide, also referred to as biogas, is produced. The amount of gas produced varies with the amount of organic waste fed to the digester and temperature influences the rate of decomposition and gas production.

Anaerobic digestion occurs in four steps:

• **Hydrolysis** : Complex organic matter is decomposed into simple soluble organic molecules using water to split the chemical bonds between the substances.

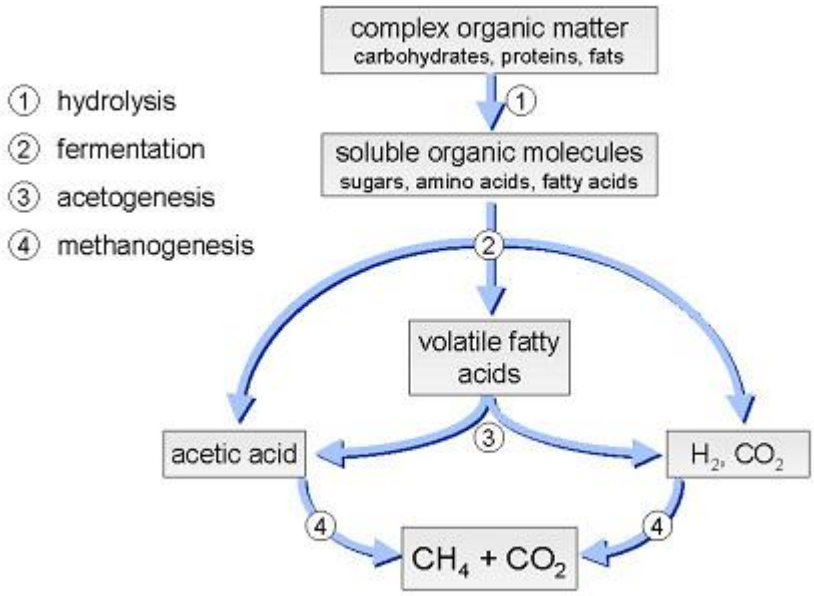
• **Fermentation or Acidogenesis:** The chemical decomposition of carbohydrates by enzymes, bacteria, yeasts, or molds in the absence of oxygen.

• **Acetogenesis:** The fermentation products are converted into acetate, hydrogen and carbon dioxide by what are known as acetogenic bacteria.

• **Methanogenesis:** Is formed from acetate and hydrogen/carbon dioxide by methanogenic bacteria.

The acetogenic bacteria grow in close association with the methanogenic bacteria during the fourth stage of the process. The reason for this is that the conversion of the fermentation products by the acetogens is thermodynamically only if the hydrogen concentration is kept sufficiently low. This requires a close relationship between both classes of bacteria.

The anaerobic process only takes place under strict anaerobic conditions. It requires specific adapted bio-solids and particular process conditions, which are considerably different from those needed for aerobic treatment.



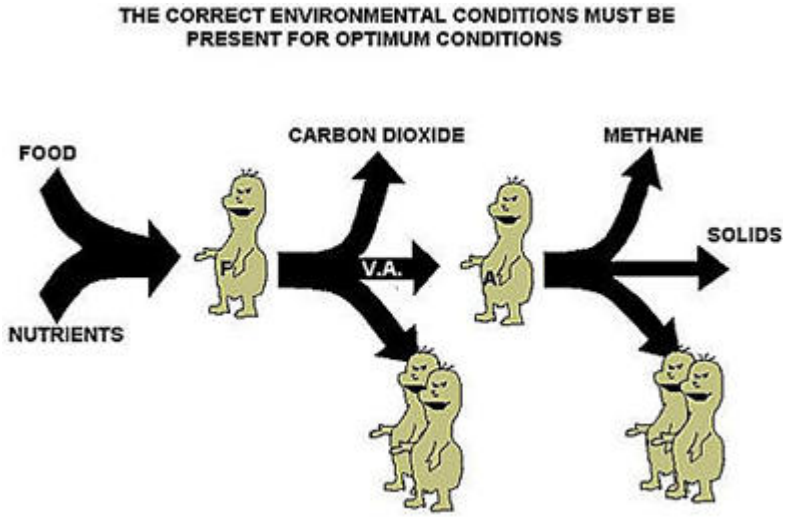
Path of Anaerobic Digestion

Advantages of Anaerobic Digestion

Wastewater pollutants are transformed into methane, carbon dioxide and smaller amount of bio-solids. The biomass growth is much lower compared to those in the aerobic processes. They are also much more compact than the aerobic bio-solids.

Anaerobic Decomposition

A biological process, in which, decomposition of organic matter occurs without oxygen. Two processes occur during anaerobic decomposition. First, facultative acid forming bacteria use organic matter as a food source and produce volatile (organic) acids, gases such as carbon dioxide and hydrogen sulfide, stable solids and more facultative organisms. Second, anaerobic methane formers use the volatile acids as a food source and produce methane gas, stable solids and more anaerobic methane formers. The methane gas produced by the process is usable as a fuel. The methane former works slower than the acid former, therefore the pH has to stay constant consistently, slightly basic, to optimize the creation of methane. You need to constantly feed it sodium bicarbonate to keep it basic.



The aerobic, anoxic, and anaerobic process helps prepare the waste for decomposition by attacking the organic compounds that in wastewater. In aerobic decomposition the only microorganisms that can survive are the aerobic organisms. In anoxic decomposition the microorganisms use chemically combined oxygen that is found in nitrite and nitrate. In this process the organisms consume the organic matter to help support their life functions. In the first stage of anaerobic decomposition, acid forming bacteria use the organic matter for food which produces volatile gases, acids and facultative organisms. Second stage methane formers use the volatile acids as a food source and that produces more gases. This gas can be used as fuel.

BIOCONVERSION OF POLLUTANTS

The term **Bioconversion**, also known as biotransformation refers to the use of live organisms often microorganisms to carry out a chemical reaction that is more costly or not feasible nonbiologically. These organisms convert a substance to a chemically modified form. An example is the industrial production of cortisone. One step is the bioconversion of Progesterone to 11-alpha-Hydroxyprogesterone by *Rhizopus nigricans.*

Another example of this is the conversion of organic materials, such as plant or animal waste, into usable products or energy sources by biological processes or agents, such as certain microorganisms, some Detritivores or enzymes.

The conversion of organic materials, such as plant or animal waste, into usable products or energy sources by biological processes or agents, such as certain microorganisms. (david)

The Bioconversion Science and Technology group performs multidisciplinary R&D for the Department of Energy's (DOE) relevant applications of bioprocessing, especially with biomass. Bioprocessing combines the disciplines of chemical engineering, microbiology and

biochemistry. The Group 's primary role is investigation of the use of microorganism, microbial consortia and microbial enzymes in bioenergy research.

New cellulosic ethanol conversion processes have enabled the variety and volume of feedstock that can be bioconverted to expand rapidly. Feedstock now includes materials derived from plant or animal waste such as paper, auto-fluff, tires, fabric, construction materials, municipal solid waste (MSW), sludge, sewage, etc.

Three different processes for bioconversion

1 - **Enzymatic hydrolysis** - a single source of feedstock, switchgrass for example, is mixed with strong enzymes which convert a portion of cellulosic material into sugars which can then be fermented into ethanol. Genencor and Novozymes are two companies that have received United States government Department of Energy funding for research into reducing the cost of cellulase, a key enzyme in the production cellulosic ethanol by this process.

2 - **Synthesis gas fermentation** - a blend of feedstock, not exceeding 30% water, is gasified in a closed environment into a syngas containing mostly carbon monoxide and hydrogen. The cooled syngas is then converted into usable products through exposure to bacteria or other catalysts. BRI Energy, LLC is a company whose pilot plant in Fayetteville, Arkansas is currently using synthesis gas fermentation to convert a variety of waste into ethanol. After gasification, anaerobic bacteria (*Clostridium ljungdahlii*) are used to convert the syngas (CO, CO_2, and H_2) into ethanol. The heat generated by gasification is also used to co-generate excess electricity.

3 - **Grub Composting** is a sustainable technology that employ organisms that feed on organic matter to reduce and convert organic waste in to high quality feedstuff and oil rich material for the biodiesel industry. Organizations pioneering this novel approach to waste management are EAWAG, ESR International, Prota Cultureand BIOCONVERSION that created the *e*-CORS® system to meet large scale organic waste management needs and environmental sustainability in both urban and livestock farming reality. This type of engineered system introduces a substantial innovation represented by the automatic modulation of the treatment, able to adapt conditions of the system to the biology of the scavenger used, improving their performances and the power of this technology.