

# **GGEG 51003-ENVIRONMENTAL SCIENCE AND SUSTAINABLE DEVELOPMENT**

## **UNIT-I**

### **INTRODUCTION AND NATURAL RESOURCES**

#### **1.1 INTRODUCTION**

The word Environment is derived from the French word “Environ” which means “surrounding”. Our surrounding includes biotic factors like human beings, Plants, animals, microbes, etc and abiotic factors such as light, air, water, soil, etc.

Environment is a complex of many variables, which surrounds man as well as the living organisms.

Environment includes water, air and land and the interrelationships which exist among and between water, air and land and human beings and other living creatures such as plants, animals and microorganisms.

The natural environment consists of four interlinking systems namely, the atmosphere, the hydrosphere, the lithosphere and the biosphere. These four systems are in constant change and such changes are affected by human activities and vice versa.

#### **Components of Environment**

Environment has been classified into four major components:

1. Hydrosphere,
2. Lithosphere,
3. Atmosphere,
4. Biosphere.

**Hydrosphere** includes all water bodies such as lakes, ponds, rivers, streams and ocean etc. Hydrosphere functions in a cyclic nature, which is termed as hydrological cycle or water cycle. Lithosphere means the mantle of rocks constituting the earth's crust.

The earth is a cold spherical solid planet of the solar system, which spins in its axis and revolves around the sun at a certain constant distance.

**Lithosphere** mainly, contains soil, earth rocks, mountain etc. Lithosphere is divided into three layers-crusts, mantle and core (outer and inner).

**Atmosphere** The cover of the air, that envelope the earth is known as the atmosphere.

**Atmosphere** is a thin layer which contains gases like oxygen, carbon dioxide etc. and which protects the solid earth and human beings from the harmful radiations of the sun.

There are five concentric layers within the atmosphere, which include the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.

**Biosphere** it is otherwise known as the life layer, it refers to all organisms on the earth's surface and their interaction with water and air.

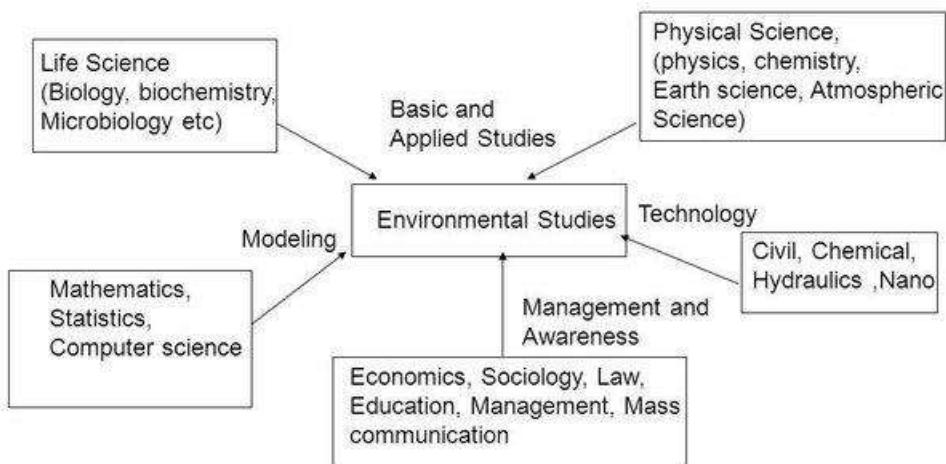
It consists of plants, animals and micro-organisms, ranging from the tiniest microscopic organism to the largest whales in the sea.

## MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

**Environmental science** is an interdisciplinary academic field that integrates physical and biological sciences, (including but not limited to Ecology, Physics, Chemistry, Biology, Soil Science, Geology, Atmospheric Science and Geography) to the study of the environment, and the solution of environmental problems. Environmental science provides an integrated, quantitative, and interdisciplinary approach to the study of environmental systems.

Environmental scientists work on subjects like the understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management, and the effects of global climate change. Environmental issues almost always include an interaction of physical, chemical, and biological processes.

The multidisciplinary nature of environmental science is illustrated in following diagram



## **Ecosystem Structure and Function**

The study of ecosystems mainly consists of the study of the processes that link the leaving organism or in other words biotic component to the non-living organism or a biotic component. So for the study of environment we should aware with biotic and a biotic component.

## **Natural Resource Conservation**

For managing and maintenance of forests which are natural resources and for the maintenance of wildlife forms task under natural resource conservation. It is also a scope of environmental studies

## **Environmental Pollution Control**

With the knowledge of environmental science everybody can control the pollution. He/she can handle the waste management and also look for ways to control pollution on the aspect of pollution control.

## **Environmental management**

There are several independent environmental consultants who are working with Central and State pollution control Board. They offer advice to solve the problems of environment the optimum solution for the upcoming problems. They give direction for controlling pollution due to industrial development. There are several current consultants who are working with government pollution control boards, involved in policy making, pollution control and maintenance of ecological balance.

## **The scope of environmental studies in industry**

Environmental scientist's work towards maintenance of ecological balance, they also work towards conservation of biodiversity and regulation of natural resources as well as on preservation of natural resources. Most of the industries have a separate environmental research and development section. These sections govern the impact that their industry has on the environment. Our environment is being degraded by the rapid industrialization. To combat this

menace there is a growing trend towards manufacture of "green" goods and products. So we can say that there is a good scope in the field of industry from environmental studies.

## **IMPORTANCE OF ENVIRONMENT SCIENCE**

The environment studies enlighten us, about the importance of protection and conservation of our indiscriminate release of pollution into the environment.

Environment science has become significant for the following reasons:

### **1. Environment Issues Being of International Importance**

It has been well recognized that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

### **2. Problems Cropped in the Wake of Development**

Development, in its wake gave birth to Urbanization, Industrial Growth, and Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed World. The North, to cleanse their own environment has fact fully, managed to move 'dirty' Factories of South.

### **3. Explosively Increase in Pollution**

World census reflects that one in every seven persons in this planted lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land.

Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

### **4. Need to Save Humanity from Extinction**

It is incumbent upon us to save the humanity from extinction. Consequent to our activities Constricting the environment and depleting the biosphere, in the name of development.

### **5. Need for Wise Planning of Development**

Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to be synchronized with the ecological cycles in any plan of development our actions should be planned ecologically for the sustenance of the environment and development.

## **NEED FOR PUBLIC AWARENESS**

It is essential to make the public aware of the formidable consequences of the Environmental Degradation, if not retorted and reformative measures undertaken would result in the extinction of life. We are facing various environmental challenges. It is essential to get the country acquainted with these challenges so that their acts may be eco-friendly.

Some of these challenges are as under:

### **1. Growing Population**

A population of over thousands of millions is growing at 2.11 per cent every year. Over 17 million people are added each year. It puts considerable pressure on its natural resources and reduces the gains of development. Hence, the greatest challenge before us is to limit the population growth. Although population control does automatically lead to development, yet the development leads to a decrease in population growth rates. For this development of the women is essential.

### **2. Poverty**

India has often been described a rich land with poor people. The poverty and environmental degradation have a nexus between them. The vast majority of our people are directly dependent on the nature resources of the country for their basic needs of food, fuel shelter and fodder. About 40% of our people are still below the poverty line.

Environment degradation has adversely affected the poor who depend upon the resources of their immediate surroundings. Thus, the challenge of poverty and the challenge environment degradation are two facets of the same challenge. The population growth is essentially a function of poverty. Because, to the very poor, every child is an earner and helper and global concerns have little relevance for him.

### **3. Agricultural Growth**

The people must be acquainted with the methods to sustain and increase agricultural growth with damaging the environment. High yielding varieties have caused soil salinity and damage to physical structure of soil.

### **4. Need to Ground water**

It is essential of rationalizing the use of groundwater. Factors like community wastes, industrial effluents and chemical fertilizers and pesticides have polluted our surface water and affected quality of the groundwater.

It is essential to restore the water quality of our rivers and other water bodies as lakes are an important challenge. It so finding our suitable strategies for consecration of water, provision of safe drinking water and keeping water bodies clean which are difficult challenges is essential.

### **5. Development and Forests**

Forests serve catchments for the rivers. With increasing demand of water, plan to harness the mighty river through large irrigation projects were made. Certainly, these would submerge forests; displace local people, damage flora and fauna. As such, the dams on the river Narmada, Bhagirathi and elsewhere have become areas of political and scientific Debate.

## **1.2 NATURAL RESOURCES**

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

**Natural resources** are naturally occurring substances that are considered valuable in their relatively unmodified (natural) form. A natural resource's value rests in the amount of the material available and the demand for it. The term was introduced to a broad audience by E.F. Schumacher

in his 1970s book Small is Beautiful.

**a) Renewable resource or inexhaustible resources**

The renewable resources can maintain themselves or can be replaced if managed wisely. These resources are constantly renewed in nature. The renewable resources are therefore not likely to be lost due to excessive and unwise use.

**b) Non-renewable resources or exhaustible resources**

These resources once used are lost forever, as they are not restored. They include metallic minerals and fossil fuels. At current rates of usage, all the industrial metals may lose for less than a century and those of petroleum and natural gas may exhaust in 15-20 years.

It is a matter of much concern and ensures a balance between population growth and utilization of resources. This overutilization creates many problems. In some regions there are problems of water logging due to over irrigation. In some areas, there is no sufficient water for industry and agriculture. Thus, there is need for conservation of natural resources.

There are many problems associated with natural resources:

**Forest resources and associated problems**

1. Use and over-exploitation.
2. Deforestation.
3. Timber extraction.
4. Mining and its effects on forest.
5. Dams and their effects on forests and tribal people.

**Water resources and associated problems**

1. Use and overutilization of water.
2. Floods, droughts etc.
3. Conflicts over water.
4. Dams and problems.

**Mineral resource and associated problems**

1. Use and exploitation.
2. Environmental effects of extracting and using minerals.

**Food resources and associated problems**

1. World food problems.
2. Changes caused by agriculture and over grazing.
3. Effects of modern agriculture.
4. Fertilizer-pesticide problems.
5. Water logging and salinity.

**Energy resources and associated problems**

1. Growing energy needs.

**Land resources and associated problems**

1. Land degradation.
2. Man-induced landslides.
3. Soil erosion and desertification.

### **1.3 FOREST RESOURCES**

Forests are one of the most important natural resources and a part of biosphere since these are natural assets on this earth. Forests predominantly composed of trees, shrubs, woody vegetation etc.

Approximately 1/3rd of the earth's total land area is covered by forests. Forests are important ecologically and economically.

Ecologically forests are to be considered as earth's lungs because they consume CO<sub>2</sub> and release O<sub>2</sub> which is required for sustaining the life on this earth.

The poisonous gas CO<sub>2</sub> is absorbed by the trees of forests and reduces the global warming and helps to continue hydrological cycle, reduce soil erosion. Forest ecosystems are extremely good & hold a good quantity of water.

Economically forests provide timber, fodder to grazing animals, firewood (conventional fuel), bamboos, rubbers, medicines, gums, resins, food items etc.

### **USES OF FOREST**

#### **1. Watershed protection:**

- Reduce the rate of surface run-off of water.
- Prevent flash floods and soil erosion.
- Produces prolonged gradual run-off and thus prevent effects of drought.

#### **2. Atmospheric regulation:**

- Absorption of solar heat during evapo-transpiration.
- Maintaining carbon dioxide levels for plant growth.
- Maintaining the local climatic conditions.

#### **3. Erosion control:**

- Holding soil (by preventing rain from directly washing soil away).

#### **4. Land bank:**

- Maintenance of soil nutrients and structure.

#### **5. Local use - Consumption of forest produce by local people who collect it for subsistence – (Consumptive use)**

• Food - gathering plants, fishing, hunting from the forest. (In the past when wildlife was Plentiful, people could hunt and kill animals for food. Now those populations of most Wildlife species have diminished; continued hunting would lead to extinction.)

- Fodder - for cattle.
- Fuel wood and charcoal for cooking, heating.
- Poles - building homes especially in rural and wilderness areas.
- Timber – household articles and construction.
- Fiber - weaving of baskets, ropes, nets, string, etc.
- Sericulture – for silk.
- Apiculture - bees for honey, forest bees also pollinate crops.
- Medicinal plants - traditionally used medicines, investigating them as potential Source for new

modern drugs.

#### **6. Market use - (Productive use)**

- Most of the above products used for consumptive purposes are also sold as source of income for supporting the livelihoods of forest dwelling people.
- Minor forest produce - (non-wood products): Fuel wood, fruit, gum, fiber, etc. which are Collected and sold in local markets as a source of income for forest dwellers.
- Major timber extraction - construction, industrial uses, paper pulp, etc. Timber extraction is done in India by the Forest Department, but illegal logging continues in many of the forests of India and the world.

### **OVER EXPLOITATION OF FORESTS**

Forest has been known to possess huge potential for human use and they have been exploited since early times for their vast potential. Exploitation of forest has taken place to meet human demands in the following ways:

- Due to wood cutting and large scale logging for raw materials like timber, pulp wood, fuel wood etc
- Deforestation due to road construction
- Clearing of forest to create more agricultural lands to meet the food needs of growing population
- Encroachment of forests leading to destruction of about 19.57 lakh hectares (2013) of forest in the country
- About 78% of forest area is under heavy grazing
- Mining activities leads to clearing of forests
- Big hydro electric projects result in large scale destruction of forest

In India, **Joint forest management** has come up as innovative approach involving community participation so that the rural economy is strengthened as well as forest resources are conserved through public involvement

### **DEFORESTATION**

Deforestation is the permanent destruction of indigenous forests and woodlands. The term does not include the removal of industrial forests such as plantations of gums or pines. Deforestation has resulted in the reduction of indigenous forests to four-fifths of their pre-agricultural area. Indigenous forests now cover 21% of the earth's land surface. Deforestation refers to the loss of forest cover (or) the aimless destruction of trees. The clearing of forests across the earth has been occurring on a large scale basis for many centuries. This process involves the cutting down, burning and damaging of forests. Currently 12 million hectares of forests are cleared annually and the current rate of deforestation continues, the world's forests will vanish within the next 100 years about 80% of the original forests on the earth have already been cleared.

#### **Major causes of Deforestation:**

- a. **Shifting cultivation:** There are an estimated 300 million people living as shifting cultivators who practice slash and burn agriculture and are supported to clear more than 5 lakh ha of forests for shifting cultivation annually. In India, we have this practice of North-East and to some extent in

Andhra Pradesh, Bihar and M.P. which contribute to nearly half of the forest clearing annually.

b. **Fuel requirements:** Increasing demands for fuel wood by the growing population in India alone has shoted up to 300-500 million tons in 2001 as compared to just 65 million tons during independence, thereby increasing the pressure on forests.

c. **Raw materials for industrial use:** Wood for making boxes, furniture, railway-sleepers, plywood, match boxes, pulp for paper industry etc. have exerted tremendous pressure on forests. Plywood is in great demand for packing tea for Tea industry of Assam while fir tree wood is exploited greatly for packing apples in J & K.

d. **Development projects:** Massive destruction of forests occurs for various development projects like hydroelectric projects, big dams, road construction, mining etc.

e. **Growing food needs:** In developing countries this is the main reason for deforestation. To meet the demands of rapidly growing population, agricultural lands and settlements are created permanently by clearing forests.

f. **Overgrazing:** The poor in the tropics mainly rely on wood as a source of fuel leading to loss of tree cover and the cleared lands are turned into the grazing lands. Overgrazing by the cattle leads to further degradation of these lands.

g. Conversion of forests and woodlands to agricultural land to feed growing numbers of people

#### **Major activities and threats to Forests resources:**

**1.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 a by vines etc. Also road construction for making approach to the trees causes further damage to the forests. The steps in timber extraction are:

- a) Clear felling
- b) Mechanized logging
- c) Manual logging
- d) Selective logging

**2. Mining:** Mining operations for extracting minerals and fossil fuels like coal often involves vast forest areas. Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining. More than 80000 ha of land of the country is presently under the stress of mining activities. Mining and its associated activities require removal of vegetation along with underlying soil mantle and overlying rock masses. This results in defacing the topography and destruction of the landscape in the area. Large scale deforestation has been reported in Mussorie and Dehradun valley due to indiscriminating mining of various minerals over a length of about 40 Km.

#### **DAMS AND OTHER EFFECTS ON FOREST AND TRIBAL PEOPLE**

Forest are directly being indirectly effected by the forest. Hydro-electric dams are main cause for deforestation. About 40,000 large dams are currently obstructing Workloads Rivers. Destruction of forest occurs for constructing big dams, which alters ecological balance. In these way landslides,

droughts and floods conditions may rise in area. Socio-economic problems related to tribal and native people results from big dam construction

Dam construction produces a number of health hazards. Thousands of workers who build the dams attacked by the diseases like AIDS, measles, tuberculosis, syphilis etc. Dam building has resulted in wide range human rights violations. Rehabilitation policy of the government is important and typical when most of the displaced persons are tribal people. Tribal life and culture are mostly associated with forest

## **WATER RESOURCES**

**Water resources** are sources of water that are useful or potentially useful. Uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water.

### **Distribution of water on earth:**

- 97% of the water on the Earth is salt water. Only three percent is fresh water; slightly over two thirds of this is frozen in glaciers and polar ice. The remaining unfrozen freshwater is found mainly as groundwater, with only a small fraction present above ground or in the air

Fresh water occurs mainly in two forms

1. Ground water and 2. Surface water

1. Groundwater: About 9.86% of the total fresh water resources is in the form of groundwater and it is about 35-50 times that of surface water supplied

### **USES OF WATER:**

1. DOMESTIC USE: Water used in the houses for the purposes of drinking, bathing, washing Clothes, cooking, sanitary & other needs. The recommended value according to Indian standard specification for domestic use is 135 liters/day
2. INDUSTRIAL USE: Water is required for various industries such as cement, mining, textile, leather industries.
3. PUBLIC USE: This includes water used for public utility purpose such as watering parks, Flushing streets, jails etc.
4. FIRE USE: Water is used in case of accidents and to prevent the fire issues.

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

6. OTHER USES: Hydroelectric power generation requires water.

## OVER UTILIZATION OF GROUND WATER AND SURFACE WATER

Over use of groundwater has following effects.

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

The reasons for shortage of water are:

- a. Increase in population,
- b. Increasing demand of water for various purposes.
- c. Unequal distribution of fresh water.
- d. Increasing pollution of water sources cause over exploitation.

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

3. **Drought.** A drought is an extended period of months or years when a region notes a deficiency in its water supply whether surface or underground water. Generally, this occurs when a region receives consistently below average precipitation.

We can define drought in four main ways:

- a) **Meteorological drought:** related to rainfall amounts
- b) **Hydrological drought:** determined by water levels in reservoirs
- c) **Agricultural drought:** related to the availability of water for crops
- d) **Socioeconomic Drought:** related to demand and supply of economic goods

a) **Meteorological Drought:** Meteorological drought is generally defined by comparing the rainfall in a particular place and at a particular time with the average rainfall for that Place. The definition is, therefore, specific to a particular location. Meteorological drought leads to a depletion of soil moisture and this almost always has an impact on crop production.

b) **Hydrological Drought:** Hydrological drought is associated with the effect of low rainfall on water levels in rivers, reservoirs, lakes and aquifers. Hydrological droughts usually are noticed some time after meteorological droughts. First precipitation decreases and, Sometime after that, water levels in rivers and lakes drop.

C) **Agricultural Drought:** Agricultural drought mainly effects food production and farming. Agricultural drought and precipitation shortages bring soil water deficits, reduced ground water or reservoir levels, and so on. Deficient topsoil moisture at planting may stop germination, leading to low plant populations.

d) **Socioeconomic Drought:** Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Due to variability of climate, water supply is sufficient in some years but not satisfactory to meet human and environmental needs in other year

## FLOODS

A **flood** is an overflow of water that submerges land which is normally dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an area flood. Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers.

## CONFLICTS OVER WATER

**Water conflict** is a term describing a conflict between countries, states, or groups over an access to water resources. The United Nations recognizes that water disputes result from opposing interests of water users, public or private.

A wide range of water conflicts appear throughout history, though rarely are traditional wars waged over water alone. Instead, water has historically been a source of tension and a factor in conflicts that start for other reasons. However, water conflicts arise for several reasons, including territorial disputes, a fight for resources, and strategic advantage.

These conflicts occur over both freshwater and saltwater, and between international boundaries. However, conflicts occur mostly over freshwater; because freshwater resources are necessary, yet limited, they are the center of water disputes arising out of need for potable water. As freshwater is a vital, yet unevenly distributed natural resource, its availability often impacts the living and economic conditions of a country or region. The lack of cost-effective water desalination techniques in areas like the Middle East, among other elements of water crises can put severe pressures on all water users

According to the 1992 International Conference on Water and the Environment, Water is a vital element for human life, and any human activity relates somehow to water. Unfortunately, it is not a renewable resource and in the future it "might get worse with climate change"

Water conflicts occur because the demand for water resources and potable water extend far beyond the amount of water actually available. Elements of a water crisis may put pressures on affected parties to obtain more of a shared water resource, causing diplomatic tension or outright conflict.

**The Cauvery water dispute:** Out of India's 18 major rivers, 17 are shared between different states. In all these cases, there are intense conflicts over these resources which badly seem to resolve. The Cauvery river water is a bone of contention between Tamil Nadu and Karnataka and the problem is almost hundred years old. Tamil Nadu occupying the downstream region of the river wants water-use regulated in the upstream state Karnataka refuses to do so and claims its priority over the river as upstream user. The river water is almost fully utilized and both the

states having increasing demands for agriculture and industry. The consumption is more in Tamilnadu than Karnataka where the catchment area is rockier. On June 2, 1990, the Cavery Water dispute tribunal was set up which through an interim award directed Karnataka to ensure that 205 TMCF of water was made available in Tamilnadu mettur dam every year, till a settlement was reached. In 1991-92 due to good monsoon, there was no dispute as there was good stock of water in Mettur, but 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 there was a complex cropping pattern in Cauvery basin. Sambra paddy in winter, Kurvai 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 and rational sharing patterns, and pricing of water are suggested as some measures to solve the problem.

## **DAMS-BENEFITS AND PROBLEMS**

Today there are more than 45,000 large dams around the world, which play an important role in communities and economies that harness these water resources for their economic development. Current estimates suggest some 30-40% of irrigated land worldwide relies on dams. Hydropower, another contender for the use of stored water, currently supplies 19% of the world's total electric power supply and is used in over 150 countries. The world's two most populous countries – China and India – have built around 57% of the world's large dams.

### **BENEFITS:**

River valley projects with big dams have usually been considered to play a key role in the development process due to their multiple uses. India has the distinction of having the largest number of river valley projects. The tribal's living in the area pin big hopes on these projects as they aim at providing employment and raising the standard and quality of life. The dams have tremendous potential for economic upliftment and growth. They can help in checking floods and famines, generate electricity and reduce water and power shortage, provide irrigation water to lower areas, provide drinking water in remote areas and promote navigation, fishery etc

### **PROBLEMS:**

- Fragmentation and physical transformation of rivers.
- Serious impacts on riverine ecosystems.
- Social consequences of large dams due to displacement of people.
- Water logging and Stalinization of surrounding lands.
- Dislodging animal populations, damaging their habitat and cutting off their migration routes.
- Fishing and travel by boat disrupted.

Large dams have had serious impacts on the lives, livelihoods, cultures and spiritual existence of indigenous and tribal peoples. They have suffered disproportionately from the negative Impacts of dams and often been excluded from sharing the benefits. In India, of the 16 to 18 million people displaced by dams, 40 to 50% were tribal people, who account for only 8% of our nation's one billion people.

# MINERAL RESOURCES

A mineral is a naturally occurring substance of definite chemical composition and identifiable physical properties.

An ore is a mineral or combination of minerals from which a useful substance, such as a metal, can be extracted and used to manufacture a useful product.

The geological processes are caused for the formation of the minerals over millions of years ago in the earth's crust. Minerals are generally localized in occurrence and the deposits are very sporadic in distribution.

Mineral resources are non-renewable and the mineral /ore is extracted by the process of mining. Iron, aluminum, zinc, manganese and copper are important raw materials for industrial use. Important non-metal resources include coal, salt, clay, cement and silica.

Stone used for building material, such as granite, marble, limestone, constitute another category of minerals. Minerals with special properties that humans value for their aesthetic and ornamental value are gems such as diamonds, emeralds and rubies.

The luster of gold, silver and platinum is used for ornaments. Minerals in the form of oil, gas and coal were formed when ancient plants and animals were converted into underground fossil fuels.

## Uses of minerals:

Minerals are used in a large number of ways for domestic, industrial, commercial Sectors etc...

1. Generation of energy by using coal (lignite / anthracite); uranium, gold, silver, platinum, diamond is used in jewellery. Copper, aluminum etc are used as cables for transmission of power.
2. Some of the minerals are used in ayurvedam as medicine.

Gold is reputed to strengthen the heart muscle and increase energy and stamina.

## Mining and its Process:

Minerals and their ores need to be extracted from the earth's interior so that they can be used. This process is known as mining.

**Mining** is the extraction of valuable minerals or other geological materials from the earth, from an ore body, lode, vein, (coal) seam or reef, which forms the mineralized horizon and package of economic interest to the miner.

Mining operations generally progress through four stages:

- (1) Prospecting: Searching for minerals.
- (2) Exploration: Assessing the size, shape, location,
- (3) Development: Work of preparing access to the deposit so that the minerals can be extracted from it.
- (4) Exploitation: Extracting the minerals from the mines.

## Types of mining:

The method of mining has to be determined depending on whether the ore or mineral deposit is

nearer the surface or deep within the earth.

The topography of the region and the Physical nature of the ore deposit is studied. Mines are of two types

- a) Surface (open cut or strip mines)
- b) Deep or shaft mines.

**a) Surface Mining:** Surface mining is used to obtain mineral ores that are close to Earth's Surface. The soil and rocks over the ore are removed by blasting.

Typically, the remaining ore is drilled or blasted so that large machines can fill trucks with the broken rocks. The trucks take the rocks to factories where the ore will be separated from the rest of the rock. Surface mining includes open-pit mining, quarrying, and strip mining.

- 1) Open-pit mining creates a big pit from which the ore is mined. The size of the pit grows until it is no longer profitable to mine the remaining ore.
- 2) Strip mines are similar to pit mines, but the ore is removed in large strips.
- 3) A quarry is a type of open-pit mine that produces rocks and minerals that are used to make buildings.

**b) Underground Mining:** Underground mining is used for ores that are deep in Earth's surface. For deep ore deposits, it can be too expensive to remove all of the rocks above the ore. Underground mines can be very deep.

The deepest gold mine in South Africa is more than 3,700 meters deep (that is more than 2 miles)! There are various methods of underground mining.

These methods are more expensive than surface mining because tunnels are made in the rock so that miners and equipment can get to the ore.

Underground mining is dangerous work. Fresh air and lights must also be brought in to the tunnels for the miners. Miners breathe in lots of particles and dust while they are underground.

The ore is drilled, blasted, or cut away from the surrounding rock and taken out of the tunnel

#### **Environmental effects:**

Mineral extraction and processing in mines involves a negative impact on environment. Much risk is involved in mining process because of high temperature, pressure Variations, fire hazards and lack of ventilation in mines.

- Mining process involves removal of over burden of soil, ore extraction & transportation, crushing & grinding of ore, water treatment of ore, storage of waste material.
- As a result of these activities cause air pollution, noise pollution, water pollution, loss of habitat of wildlife, concentration of toxic substances in tailing ponds and spreading of dust.
- People working in mines often suffer from serious respiratory system and skin diseases.
- Mining often causes ground subsidence which results in tilting of buildings, cracks in houses, buckling of roads, bending of rail tracks etc.
- Exploration process before a mining involves, geochemical, geophysical surveys  
Drilling activities which causes for air pollution, noise pollution etc...

- In addition, disturbance of all vegetation (flora) and fauna (animals) from that a region.
- **Acid mine drainage** (AMD), or **acid rock drainage** (ARD): The outflow of acidic water from (usually abandoned) metal mines or coal mines. However, other areas where the earth has been disturbed (e.g. construction sites, subdivisions, transportation corridors, etc.) may also contribute acid rock drainage to the environment

## FOOD RESOURCES

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

## CHANGES CAUSED BY AGRICULTURE AND OVER GRAZING

### CHANGES CAUSED BY AGRICULTURE

There are two types of agricultural systems:

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

#### (1) Traditional system:

The traditional system is again subdivided into two types namely:

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

(b) **Traditional Intensive Agriculture** (TIA): Farmers increase their inputs of human labor,

Water fertilizers to get higher yields for the use of their families and to sell small quantities for getting income.

(2) **Modern and industrialized system:** In the system of **modern and industrialized agriculture**, a large extent of land will be brought under agriculture and huge quantities of fuel, energy, water, chemical fertilizers, pesticides used to produce large quantities of single crops purely for sale. This system is spreading in India in the name of Green revolution.

But this modern agricultural system has its own adverse effects on environment.

a. Excessive use of chemical fertilizers to boost up the crop yield, contaminate groundwater with nitrate. The presence of excess of nitrate in drinking water is dangerous for human Health. Excess Nitrate reacts with hemoglobin and causes for “**Blue Baby Syndrome**” which kill the infants.

b. The excessive N P K fertilizers in agriculture fields are often washed off with water and leads to **algal blooming** and **Eutrophication**. **Phosphates** have been accumulating in soils, lake sediments for decades change the ecology. Increased levels of phosphates in water bodies cause Eutrophication ( growth of unwanted plants ).

c. The excessive use of pesticides enters the food chain and become hazardous to human life.  
d. A large area of fertile land has become saline in recent years due to excessive irrigation.

- e. Consumption of fuel energy is more when shifting of human and animal labour to agriculture machinery. Use of fuel leads to air pollution.
- f. Continuing to increase input of fertilizers, water and pesticides eventually produces no Additional increase in crop yield but slows down the productivity of the crop.
- g. Due to increased irrigation, the underground **aquifers are slowly and constantly become dry**. The rate at which they are being depleted is much faster than its recharge.
- h. Excessive application of chemical fertilizers can increase soil **salt content**. The percolation of domestic and industrial sewage also increases the salinity of soil.
- i. The stagnation of water in the soil in the upper layers causes for **water logging** which Causes for less oxygen availability for respiration of plants.

## **Modern, intensive agriculture causes many problems, including the following:**

- Artificial fertilizers and herbicides are easily washed from the soil and pollute rivers, lakes and Water courses.
- The prolonged use of artificial fertilizers results in soils with a low organic matter content Which is easily eroded by wind and rain?
- Dependency on fertilizers. Greater amounts are needed every year to produce the same Yields of crops.
- Artificial pesticides can stay in the soil for a long time and enter the food chain where they build up in the bodies of animals and humans, causing health problems.
- Artificial chemicals destroy soil micro-organisms resulting in poor soil structure and aeration and decreasing nutrient availability.
- Pests and diseases become more difficult to control as they become resistant to artificial Pesticides. The numbers of natural enemies decrease because of pesticide use and habitat loss.

## **WATER LOGGING**

Water logging refers to the saturation of soil with water. Soil may be regarded as waterlogged when the water table of the groundwater is too high to conveniently permit an anticipated activity, like agriculture.

In agriculture, various crops need air (specifically, oxygen) to a greater or lesser depth in the soil. Water logging of the soil stops air getting in.

How near the water table must be to the surface for the ground to be classed as waterlogged varies with the purpose in view.

A crop's demand for freedom from water logging may vary between seasons of the year, as with the growing of rice (*Oryza sativa*).

In irrigated agricultural land, water logging is often accompanied by soil salinity as waterlogged soils prevent leaching of the salts imported by the irrigation water

## **SALINITY**

Soil salinity is the salt content in the soil; the process of increasing the salt content is known as salinization. Salt is a natural element of soils and water. Salinization can be caused by natural processes such as mineral weathering or the gradual withdrawal of an ocean. It can also be caused by artificial processes such as irrigation

Salinization is a process that results from:

- High levels of salt in the water.
- Landscape features that allow salts to become mobile (movement of water table).
- Climatic trends that favors accumulation.
- Human activities such as land clearing, aquaculture activities and the salting of icy roads.

## CHANGES CAUSED BY OVER GRAZING

**Overgrazing** occurs when plants are exposed to intensive grazing for extended periods of time, or without sufficient recovery periods. It can be caused by either livestock in poorly managed agricultural applications, or by overpopulations of native or native wild.

Overgrazing reduces the usefulness, productivity, and biodiversity of the land and is one cause of desertification and erosion. Overgrazing is also seen as a cause of the spread of invasive species of non-native plants and of weeds.

Overgrazing typically increases soil erosion. Reduction in soil depth, soil organic matter and soil fertility impair the land's future natural and agricultural productivity.

Soil fertility can sometimes be mitigated by applying the appropriate lime and organic fertilizers. However, the loss of soil depth and organic matter takes centuries to correct. Their loss is critical in determining the soil's water-holding capacity and how well pasture plants do during dry weather.

## ENERGY RESOURCES

**Energy is defined by physicists as the capacity to do work.** Energy is found on our planet in a variety of forms, some of which are immediately useful to do work, while others require a process of transformation.

Energy can neither be created nor destroyed but transformed from one form to other. Energy is closely related to force.

When a force causes an object to move, energy is being transferred from the force to kinetic energy. Energy is present in a number of forms such as mechanical, thermal, chemical, biological energy etc..

Energy production and utilization have become essential to carry out many activities in modern life.

Energy is one of the important requirements that a country needs for its economic growth.

At the same time, energy production has its impact on environment due to pollution and finally affects the quality of life of people.

## **GROWING ENERGY NEEDS**

Energy plays a key role in the process of economic growth of a nation. The industrial development of any country is dependent on the organized development of its power resources'.

Energy is also indispensable for agriculture, transport, business and domestic requirements. In fact, electricity has such a wide range of applications in modern economic development that its per capita consumption is, to a great extent, an index of the material advancement of the country.

Energy is the capacity for doing useful work. It is an essential input for economic growth. This energy is used in the form of electrical energy, thermal energy, light, mechanical energy and chemical energy etc.

Energy is measured in joules in Si units. The annual per capita energy consumption in developed countries ranges from 5 to 11 kW whereas in the developing countries it is between 1 to 1.5 KW Only

### **Uses of Energy**

1. Energy is a primary input in any industrial operation.
2. It is also a major input in sectors such as commerce, transport, tele-communications etc.
3. The wide range of services required in the household and industrial sectors.
4. Owing to the far-reaching changes in the forms of energy and their respective roles in supporting human activities, research and training on various aspects of energy and environment have assumed great significance.

**Types of energy:** There are three main types of energy;

**A. Non-renewable B. Renewable C. Nuclear energy**

### **A. Non – renewable energy resources**

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

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

Coal is extracted by the process of mining and involves accidents due to mine collapse, ground water pollution, accumulation of poisonous material, explosive gases etc cause diseases. CO<sub>2</sub> pollution leads to greenhouse effect (global warming).

b) **Crude oil:** It is obtained in the form of liquid. The crude oil is heated up to 600°C in the oil refinery and condense the vapours of hydro – carbons. Petrol another petroleum product is refined fuels from crude oil. Petroleum products are used in large quantities in the manufacture of

detergents, plastics, fertilizers, pharmaceuticals, synthetic rubber etc. The transport sector consumes about 40% of diesel; 25% industries and 19% household and rest 16% agriculture and other sectors.

c) Natural Gas: Gas deposits are trapped from the sedimentary formations by means drilling holes into the rock formations. While burning of natural gas, the emission of CO<sub>2</sub> is less and thus reducing greenhouse effect and global warming. A total of 734 billion cubic mts of gas is estimated as proven reserves.

**B. Renewable energy resources:** Renewable energy systems use resources that are constantly replaced and are usually less polluting.

Examples include hydropower, solar, wind, and geothermal (energy from the heat inside the earth).

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

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

### **How Solar Power Works**

The sun's energy can be captured to generate electricity or heat through a system of panels or mirrors.

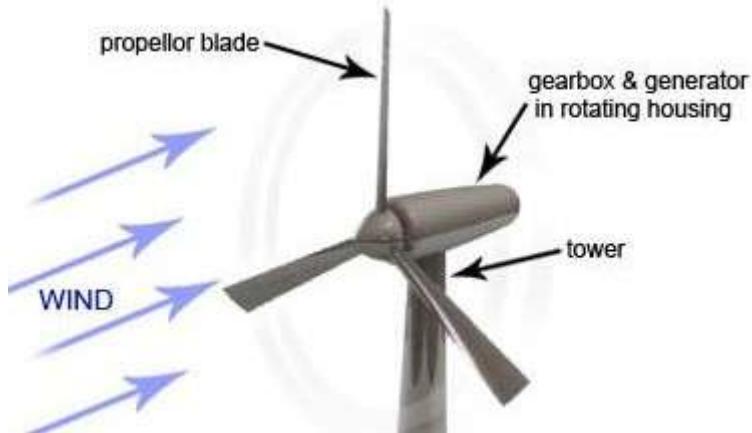
- Solar, or photovoltaic, cells convert sunlight directly into electricity. Most photovoltaic cells are made primarily of silicon, the material used in computer semiconductor chips, and arranged on rectangular panels. When sunlight hits a cell, the energy knocks electrons free of their atoms, allowing them to flow through the material. The resulting DC (direct current) electricity is then sent to a power inverter for conversion to AC (alternating current).
- Solar thermal collectors use heat-absorbing panels and a series of attached circulation tubes to heat water or buildings.
- Solar concentration systems use mirrors -- usually arranged in a series of long, parabolic troughs, a large round dish, or a circle surrounding a "power tower" -- to focus the sun's reflected rays on a heat-collecting element. The concentrated sunlight heats water or a heat-transferring fluid such as molten salt to generate steam, which is then used conventionally to spin turbines and generate electricity.
- Passive solar design is the creative use of windows, skylights and sunrooms, building site and orientation, and thermal construction materials to heat and light buildings, or to heat water, the natural way.

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

**3. Geothermal energy:** Geothermal energy found within rock formations. Inside the earth the temperature rises with depth. The temperature in earth's crust is around 4000o C. Geysers (a

natural spring that emits hot water ) and hot springs are examples for geothermal energy where the steam and hot water come to the surface, in areas where the steam is tapped by drilling. The obtained steam is then used to generate power. Air pollution results in case of geothermal energy where the gases like  $H_2S$ ,  $NH_3$ ,  $CO_2$  present in the steam coming out of the geothermal sources. The overall efficiency for power production is low (15%) as compared to fossil fuels (40%).

**4. Wind energy:** Wind energy is the kinetic energy associated with the movement of atmospheric air. Wind mills convert the wind energy into electrical energy. On an average wind mills can convert 30 – 40 % of available wind energy into electrical energy at a steady wind speed of 8.5mts / sec. The efficiency of wind mill is increased with the speed of wind and length of rotor blade. The total wind energy potential in India's estimate is 25,000 MW of this about 6000 MW is located in Tamil Nadu; 5000 MW in Gujarat and contribute the states of Andhra Pradesh, Maharashtra, Uttar Pradesh and Rajasthan for balance quantity.



#### Merits & demerits of wind energy:

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

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

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

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

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

**7. Bio-gas:** Bio-gas is a sustainable source of energy by virtue of its production from available natural organic wastes of cattle dung, human excreta, poultry waste, plant leaves, paddy husk etc.... Bio-gas is a mixture of methane (68%), CO<sub>2</sub> (31%) and N<sub>2</sub> (1%). Methane gas (CH<sub>4</sub>) is produced by bio-gas plants and this gas is utilized as cooking gas whose calorific value varies from 4400 – 6200 Kilo Calories / cum. Heat value of biogas can be improved by reducing its CO<sub>2</sub> content. Bio-gas production is carried out in an enclosed bio-gas plant made of bricks or steel. A slurry of waste organic matter is fed into the plant through an inlet and gas formed is tapped by an inverted drum. As gas is produced the drum rises and the gas may be drawn through an outlet. Bio-gas is commonly produced from cattle dung in a bio gas plant known as Gobar Gas plant. Bio-gas is a clean, cheap fuel that can be used for lighting purpose, lifting water through small pumps.

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

Energy released during nuclear reaction (mass – energy equation as per Albert Einstein's formula E = mc<sup>2</sup>).

Nuclear Energy is produced by two processes namely (1) Nuclear Fission and (2) Nuclear Fusion.

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

**Nuclear Fusion:** Nuclear energy can be generated by fusion process which involves two hydrogen atoms combine to produce one helium atom.

Eg: hydrogen bomb. The disposal of nuclear wastes during mining, fuel production and reactor operation for a long time period resulting in adverse effects on environment. Disposable of nuclear waste is a national and global problem.

## USE OF ALTERNATIVE ENERGY SOURCES

**Alternative energy** is any energy source that is an alternative to fossil fuel. These alternatives are intended to address concerns about such fossil fuels.

The nature of what constitutes an alternative energy source has changed considerably over time, as have controversies regarding energy use. Today, because of the variety of energy choices and differing goals of their advocates, defining some energy types as "alternative" is highly controversial.

In a general sense, alternative energy as it is currently conceived, is that which is produced or

recovered without the undesirable consequences inherent in fossil fuel use, particularly high carbon dioxide emissions, an important factor in global warming. Sometimes, this less comprehensive meaning of "alternative energy" excludes nuclear energy

- Solar energy is the generation of electricity from the sun. It is split up into two types, thermal and electric energy. These two subgroups mean that they heat up homes and generate electricity respectively.
- Wind energy is the generation of electricity from the wind.
- Geothermal energy is using hot water or steam from the Earth's interior for heating buildings or electricity generation.
- Biofuel and Ethanol are plant-derived substitutes of gasoline for powering vehicles.
- Nuclear binding energy uses nuclear fission to create energy.
- Hydrogen is used as clean fuel for spaceships, and some cars

## LAND RESOURCES

**Land as a resource:** Landforms such as hills, valleys, plains, river basins and wetlands include different resource generating areas that the people living in them depend on.

Many traditional farming societies had ways of preserving areas from which they used resources. If land is utilized carefully it can be considered a renewable resource. The roots of trees and grasses bind the soil.

If forests are depleted, or grasslands overgrazed, the land becomes unproductive and wasteland is formed. Intensive irrigation leads to water logging and salinization, on which crops cannot grow.

Land is also converted into a non-renewable resource when highly toxic industrial and nuclear wastes are dumped on it.

Land on earth is as finite as any of our other natural resources. While mankind has learnt to adapt his lifestyle to various ecosystems world over, he cannot live comfortably for instance on polar ice caps, on under the sea, or in space in the foreseeable future.

### LAND DEGRADATION AND CONTROL OF LAND DEGRADATION

Land degradation can be defined as any change in the land that alter its conditions or reduces its quality. Land degradation occurs due to both natural disasters like volcanic eruptions, earthquakes, heavy rains, fire etc or human induced activities.

The other causes of land degradation consist of wind blow, salinity of water, water logging, soil acidity, loss of flora and fauna.

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

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

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

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

- (a) **Contour farming:** The land is prepared with alternate furrows (a long narrow cut in the Ground) and ridges at the same level. The water is caught and held in furrows and stores which reduces run off and erosion.
- (b) **Mulching:** Stems of maize, cotton, tobacco etc are used as a mulch (decay of leaves) to reduce soil moisture, evaporation.
- (c) **Crop rotation:** Growing same crop year after year depletes the nutrients and land becomes Unproductive. This is overcome by changing the crops and cultivating legumes (plants like peas, beans) after a regular crop.
- (d) **Strip cropping:** It consists of planting crops in rows or strips along contours to check flow of water.

## **LANDSLIDES AND MAN INDUCED LAND SLIDES**

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

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

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

While landslides are a naturally occurring environmental hazard they have recently increased in frequency in certain areas due to human activities.

Building excavations collapses in mining (e.g.: coal mine) causes landslides. However, landslides can be triggered by the human beings by induced changes in the environment.

Simply landslides can be explained in three ways:

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

## **SOIL EROSION AND CAUSES FOR SOIL EROSION**

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

- a. **Deforestation:** Mining, industrial, urban development etc causes deforestation and leads to

exposure of the land to wind and rains causing soil erosion. Cutting trees leads to deforestation which in turn loss of organic matter in the soils.

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

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

## **DESERTIFICATION:**

Desertification is the process which turns productive into non- productive desert as a result of poor land-management. Desertification occurs mainly in semi-arid areas (average annual rainfall less than 600 mm) bordering on deserts. In the Sahel, (the semi-arid area south of the Sahara Desert), for example, the desert moved 100 km southwards between 1950 and 1975.

## **CAUSES OF DESERTIFICATION**

- \* Overgrazing is the major cause of desertification worldwide. Plants of semi-arid areas are adapted to being eaten by sparsely scattered, large, grazing mammals which move in response to the patchy rainfall common to these regions. Early human pastoralists living in semi-arid areas copied this natural system. They moved their small groups of domestic animals in response to food and water availability. Such regular stock movement prevented overgrazing of the fragile plant cover.
- \* Cultivation of marginal lands, i.e lands on which there is a high risk of crop failure and a very low economic return, for example, some parts of South Africa where maize is grown.
- \* Destruction of vegetation in arid regions, often for fuelwood.
- \* Poor grazing management after accidental burning of semi-arid vegetation.
- \* Incorrect irrigation practices in arid areas can cause salinization, (the buildup of salts in the soil) which can prevent plant growth.

When the practices described above coincide with drought, the rate of desertification increases dramatically.

Increasing human population and poverty contribute to desertification as poor people may be forced to overuse their environment in the short term, without the ability to plan for the long term effects of their actions. Where livestock has a social importance beyond food, people might be reluctant to reduce their stock numbers.

## **EFFECTS OF DESERTIFICATION**

Desertification reduces the ability of land to support life, affecting wild species, domestic animals, agricultural crops and people. The reduction in plant cover that accompanies desertification leads to accelerated soil erosion by wind and water. South Africa losing approximately 300-400 million

tonnes of topsoil every year. As vegetation cover and soil layer are reduced, rain drop impact and run-off increases.

Water is lost off the land instead of soaking into the soil to provide moisture for plants. Even long-lived plants that would normally survive droughts die. A reduction in plant cover also results in a reduction in the quantity of humus and plant nutrients in the soil, and plant production drops further. As protective plant cover disappears, floods become more frequent and more severe. Desertification is self-reinforcing, i.e. once the process has started, and conditions are set for continual deterioration.

#### **1.4.1 ROLE OF AN INDIVIDUAL CONSERVATION OF NATURAL RESOURCES**

Different natural resources like forests, water, soil, food, mineral and energy resources play a vital role in the development of a nation. With our small individual efforts, we can together help in conserving our natural resources to a large extent. Following are the ways:

a) Conserve Water:

1. Don't keep water taps running while brushing, shaving, washing or bathing.
2. In washing machines fill the machine only to the level required for your clothes.
3. Install water saving toilets that use not more than 6 liters per flush.
4. Check for water leaks in pipes and toilets and repair them promptly.
5. Reuse the soapy water of washing from clothes for gardening, driveways etc.
6. Water the plants and the lawns in the evening when evaporation losses are minimum. Never water the plants in mid-day.
7. Install a system to capture rain water.

b) Conserve energy:

1. Turn off lights fans and other appliances when not in use.
2. Obtain as much heat as possible from natural sources. Dry the clothes in sun instead of drier if possible.
3. Use solar cooker for cooking which will be more nutritious and will save your LPG Expenses.
4. Build your house with provision for sunspace which will keep your house warmer and will provide more light.
5. Drive less, make fewer trips and use public transportations whenever possible. Share a car-pool if possible.
6. Control the use of A.C.
7. Recycle and reuse glass, metals and papers.
8. Use bicycle or just walk down small distances instead of using vehicle.

Protect the Soil:

1. Grow different types of ornamental plants, herbs and trees in your garden. Grow grass in the open areas which will bind the soil and prevent its erosion.
2. Make compost from your kitchen waste and use it for your kitchen-garden.
3. Do not irrigate the plants using a strong flow of water as it would wash off the soil.
4. Better use sprinkling irrigation.

Promote Sustainable Agriculture:

1. Do not waste food; Take as much as you can eat.
2. Reduce the use of pesticides.
3. Fertilize your crop with organic fertilizers.
4. Use drip irrigation.
5. Eat local and seasonal vegetables.
6. Control pest